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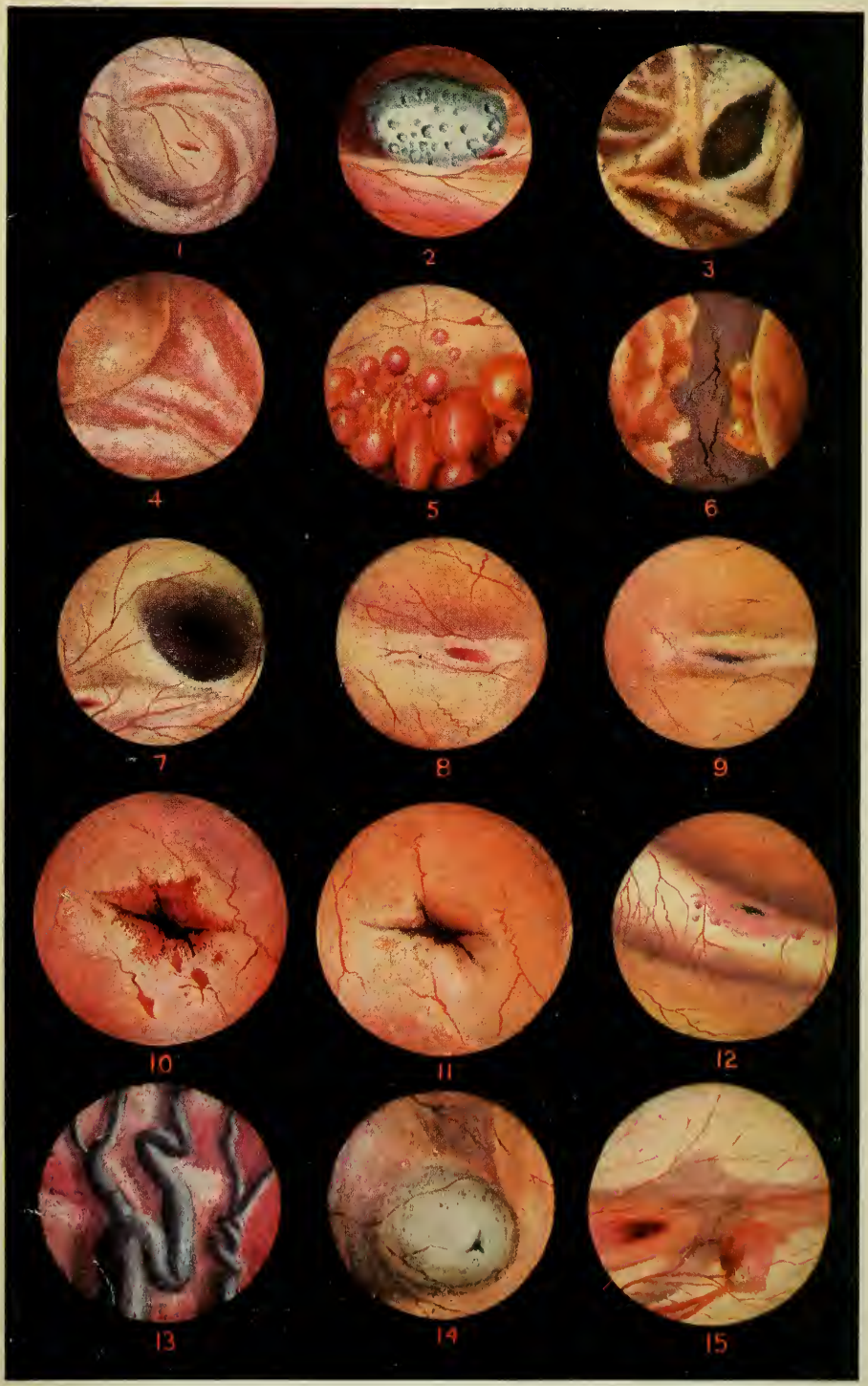

B. S. Barringer.

PLATE I

CYSTOSCOPIC VIEWS OF VARIOUS ABNORMAL CONDITIONS WITHIN THE BLADDER.

FIG. 1.—Cystocele. The ureter orifice is in a depression. All trigonal landmarks lost.

FIG. 2.—Stone of uric acid covered with xanthin (which could not be radiographed) lying near the ureter orifice.

FIG. 3.—Orifice of a saccule in a chronically inflamed and trabeculated bladder.

FIG. 4.—Depression of the fundus by extravesical carcinoma (of uterus); cystitis.

FIG. 5.—Invasion of bladder wall by uterine carcinoma; no cystitis.

FIG. 6.—Carcinoma of both lateral lobes of a hypertrophied prostate.

FIG. 7.—Diverticulum produced by adhesion of the bladder wall to uterine carcinoma.

FIGS. 8 AND 9.—Right and left ureters of a patient with left renal tuberculosis of seven years' duration. The right ureter (Fig. 8) is normal; the trigone and bladder wall on the edge of the field are congested. The left ureter (Fig. 9) is only slightly deformed and the surrounding area is congested.

FIG. 10.—Tuberculous ulceration of ureter orifice.

FIG. 11.—The same, six weeks after nephrectomy.

FIG. 12.—Tuberculous ulceration of ureter orifice.

FIG. 13.—Varicose veins of the bladder.

FIG. 14.—Intravesical ureteral cyst.

FIG. 15.—Papilloma growing near the ureter orifice. It is ulcerated and a long, narrow clot of blood is adherent to it.

UROLOGY

DISEASES OF THE URINARY ORGANS
DISEASES OF THE MALE GENITAL ORGANS
THE VENEREAL DISEASES

BY

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WITH TWO HUNDRED AND FOUR ILLUSTRATIONS IN THE TEXT AND EIGHTEEN PLATES, FOUR OF WHICH ARE COLORED

NEW YORK AND LONDON
D. APPLETON AND COMPANY
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TO

MY BELOVED FATHER

THIS BOOK IS AFFECTIONATELY
DEDICATED

PREFACE

The advance of Urology in the past decade has quite destroyed the value of the volume of which this is the successor. Not only have the sections devoted to Cystoscopy, Radiography, Renal Function Tests, Renal Infections and Tuberculosis been rewritten throughout, but the viewpoint from which we now regard Gonorrhea, Prostatism, Syphilis and many of the Operations upon the Urinary Organs has so changed that those sections also have been radically altered. Indeed excepting only those chapters descriptive of the early lesions of Syphilis not a single page of the older work but has suffered some change—we hope for the better. The general scheme of the volume remains the same, though some of the chapters have been rearranged for greater clarity of presentation, and Syphilis, which does not properly belong to Urology, has been relegated to an appendix.

The present volume is founded much more on personal clinical and pathological experience than its predecessor, and while the work of others has been freely quoted, it has seemed essential for unity of presentation that much purely statistical material be simply referred to in footnotes.

More than fifty illustrations have been added, about half of these being radiographs for the greater number of which we are indebted to Dr. Byron C. Darling; for a minority to Dr. E. W. Caldwell and Dr. L. G. Cole. Gratitude is also due to Dr. B. S. Barringer for assistance in many ways, and to Dr. E. D. Barringer, whose chapters on Gonorrhea in the Female have been retained. To the laboratory staff of Cornell University Medical College is due whatever scientific sanity this book exhibits. Its errors, in science as well as clinical matter, may be imputed only to the author.

Edward L. Keyes, Jr.

New York.

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UROLOGY

CHAPTER 1

PHYSICAL EXAMINATION

The physical examination of a patient cannot be too thorough: errors in diagnosis are more often due to incomplete or careless physical examination than to any other fault. There are in the United States today innumerable victims of renal stone and tuberculosis being treated for an imaginary cystitis. Twice I have seen prostatectomy done for pyelonephritis. Once I have seen a testis removed for syphilis and twice for subacute epididymitis, the diagnosis of tuberculosis having been erroneously made in each instance. Several patients suffering from arteriosclerotic nocturnal polyuria have been referred to me for prostatectomy. I know of a patient who submitted for months to vigorous local treatment for a mild gleet while he was dying of chronic nephritis.

Such gross errors are due to careless physical examinations. Yet it would be hard to decide precisely what constitutes a complete and careful examination. It is certainly improper, for example, to cystoscope every patient with gonorrhea; yet it is eminently essential for some of them.

The expert diagnostician shows his skill not only by basing his diagnosis on the salient points in the history and physical examination, but also and above all by recognizing the doubtful cases and exhausting for them every means of diagnosis at his command.

The general rule of physical diagnosis should therefore be this: Examine the patient to obtain a thorough knowledge not only of the disease from which he suffers but also of all possible complications and concomitant maladies that may have a bearing upon the prognosis or the treatment of this disease.

Disease of the urinary organs is peculiarly prone to be complex. That a patient has prostatitis is no evidence that he has not pyelonephritis. That he has a stone in his bladder does not prove that he has not another in his ureter. That he has a tubercular prostate does not guarantee him against renal tuberculosis. These are but gross examples of the fact that we must be constantly on our guard against com-

plex conditions in the genito-urinary tract of which the more obvious lesion may be the less important.

The detail of our physical examination should cover several fields, viz.:

General Physical Examination.
Urinalysis.
External Examination of the Genito-urinary Tract.
Internal Examination.

GENERAL PHYSICAL EXAMINATION

Though by no means always essential, yet it is never a waste of time to note the age, the weight, and the circulatory, pulmonary, and digestive conditions of every patient. That such observation is most important may be demonstrated by the following list of conditions in which data concerning the vital functions are essential:

The condition of the circulation must be carefully studied in every renal case. The blood pressure is especially important.

The condition of the lungs is preëminently important in tuberculosis and in operative cases.

The condition of the digestion is perhaps the most important of all. It affects the prognosis of even so local a malady as gonorrhea. It determines the dosage of sandalwood oil as well as of hexamethylenamin. It enters into the diagnosis of certain forms of urinary toxemia.

Study of such important factors is therefore not time wasted. Yet the detail of such study is no special province of ours: it belongs to the general education of every qualified practitioner.

URINALYSIS

Urinalysis, too, belongs to general medicine. Yet certain features of it are of such special importance in disease of the genito-urinary organs that they merit detailed consideration in Chapter II.

EXTERNAL EXAMINATION OF THE GENITO-URINARY TRACT

We may consider—

Palpation of the kidneys and ureters.
Palpation and percussion of the bladder.
Rectal palpation of the prostate and seminal vesicles, etc.
Palpation of the penis and urethra.
Palpation of the scrotal contents.

PALPATION OF THE KIDNEYS

Position of the Patient.—The patient, with back and abdomen bared, lies upon his back with his knees drawn up and his hands at his sides, so as to relax the abdominal wall as much as possible.

If examination in this position proves unsatisfactory the patient may be turned upon the side opposite to that which is being examined. Lying thus with knees well drawn up, the kidney is sometimes more palpable; but, as a rule, this is not the case.

Palpation of the abdomen with the patient erect but bending slightly forward may reveal renal mobility that otherwise escapes observation. But many patients cannot relax the abdominal muscles while in this position, which is therefore but little employed.

Position of the Examiner.—The examiner sits or stands next to the side to be examined.

The Operation.—If the kidney is very large its outlines may be determined by abdominal palpation. Yet it is almost always necessary, in order to avoid mistakes, to employ *lumbo-abdominal palpation.*

Lumbo-abdominal palpation is performed as follows: To examine the *right* kidney the patient lies, as above described, at the edge of a couch, beside which, and to the right of the patient, the examiner sits. With the index and middle fingers of the *left* hand the examiner now identifies and makes pressure upon the triangular depressible spot below the last rib and just at the edge of the thick spinal muscles. The *right* hand is then placed on the anterolateral abdominal wall (about an inch external to the linea semilunaris) with fingers directed upward, and their tips just below the free border of the ribs (or of the liver if this be enlarged). This hand is pressed down as firmly as possible, taking advantage of the relaxation of the parietes between inspirations.

Ballottement.—With the hands thus placed the examiner may or may not feel a mass between them. In either event he gives a quick, sharp tap to the loin with the fingers of the left hand. The result of this is twofold, viz.:

1. It may elicit *costovertebral tenderness.* Deep tenderness confined to the region just below the ribs and external to the erector spinae muscles is almost conclusive evidence of inflammation in or about the kidney. I have never known myositis to cause tenderness in this region.

2. It may elicit *renal ballottement.* This is the sensation, comparable to fetal ballottement, imparted to the fingers depressing the anterior parietes when a sharp tap from behind throws an intra-abdominal body against them.

Ballottement should be attempted first during normal respiration, then with the patient breathing deeply, just as the abdominal wall relaxes at the end of the inspiratory effort.

Renal ballottement discloses the presence of a movable mass in the loin. It does not prove that mass to be a kidney, nor, if kidney it be, that the organ is diseased. One may obtain ballottement from a mass of tubercular glands and from a neoplasm or "corset lobe" of the liver.

Yet as a clinical sign ballottement is most useful. When the kidney is normal in size and position ballottement can be obtained only if the patient is very thin and the abdomen very lax. But when the organ is abnormal in size or mobility and this abnormality is but slight, or when examination is impeded by fat or rigidity, ballottement may be the only clinical evidence of this change.

Thus ballottement of the kidney reveals slight enlargement or mobility, though other signs must be depended upon to prove that the mass felt actually is kidney.

Palpation.—In many instances the mass, while large enough to be felt very distinctly by ballottement, escapes every other method of lumbo-abdominal palpation except the following: The patient is instructed to take repeated deep breaths, and as he does so the examiner gradually insinuates the fingers of his right hand deeper and deeper under the ribs, until, at a propitious moment of post-inspiratory relaxation, rather sudden and sustained bimanual pressure distinctly catches the lower pole of the kidney before it slips back under the ribs.

Considerable enlargement or mobility of the kidney is better studied by simple bimanual palpation. The mass is readily felt between the hand on the loin and the hand on the abdomen, and palpation and percussion are employed to outline its shape, size, and mobility.

Percussion.—A dull or flat percussion note is obtained over the kidneys. But the presence of the liver and spleen immediately above the kidneys renders this sign of little value.

Differential Diagnosis by Palpation

Palpation of the unenlarged kidney scarcely ever affords evidence as to the exact nature of disease in it. Nephroptosis is diagnosed by palpation (p. 447), and a tender kidney is usually an inflamed kidney. Perirenal exudates are sometimes characteristically diffuse. But with these exceptions palpation usually reveals little more than the fact that a mass in the loin probably is or is not of renal origin. Retroperitoneal and adrenal growths cannot be distinguished from renal enlargement by palpation.

The enlarged kidney usually forms an ovoidal movable mass, in part concealed under the ribs, rising and falling with respiration, palpable by lumbo-abdominal palpation or ballottement. But when the kidney is greatly enlarged, or displaced and enlarged, it may be a delicate matter to distinguish the resultant tumor from enlargement

of liver, gall-bladder, spleen, or pancreas. The kidney is more lateral in position than any of these organs and more readily distinguishable by lumbo-abdominal palpation.

Insufflation of the colon [1] may be of use in differential diagnosis.

On the right side the hepatic flexure covers only the lower pole of the kidney, but is adherent thereto (by the nephrocolic ligament of Longyear). Hence if the kidney is greatly enlarged it carries the hepatic flexure forward in front of it, covering its lower extremity. Most other growths reach the abdominal wall distinctly above and to the inner side of the angle of the colon (e. g., gall-bladder, pancreas, pylorus), but enlargement of the right lobe of the liver descends external to and in front of it. Thus the only tumor whose lower end is likely to be covered by the hepatic flexure of the colon is a renal tumor.

On the left side the transverse colon crosses in front of the lower third of the kidney and the descending colon lies external to it. But the lack of any definite attachment between the two organs permits the enlarged kidney to slip out from behind the colon. When the left kidney is sufficiently large to reach the abdominal wall no hollow viscus intervenes. The descending colon borders the inner side of the mass. Enlargements of the spleen, on the other hand, reach the abdominal wall above the transverse colon.

The Ureter Catheter.—Inasmuch as disease of the kidney either impairs the secretion of that organ or alters the shape of its pelvis long before it produces a palpable tumor, the main dependence in diagnosis is upon the catheterization of the ureters. A study of the urine thus obtained, confirmed if necessary by pyelography and the wax-tipped catheter, affords an accurate diagnosis with which the findings of palpation must be made to conform.

PALPATION OF THE URETERS

The ureters lie upon the posterior abdominal parietes. Their course may be divided into an abdominal and a pelvic portion.

In the Abdomen.—The course of the ureter through the abdomen begins near the outer edge of the psoas magnus muscle opposite the third lumbar vertebra. Thence it runs on the anterior surface of this muscle downward and a little inward to pass over the brim of the pelvis near the bifurcation of the common iliac artery. At their entrance into the pelvis the ureters are about 5 cm. apart.

The normal ureter cannot be palpated through the abdominal wall. Even when considerably enlarged it can only be felt if the parietes be

[1] The apparatus for this operation is a long rectal tube and the bulb of a Paquelin cautery (or an inverted Vichy bottle).

thin and relaxed. Points of inflammation in its course may be identified as points of tenderness. But palpation cannot distinguish tenderness in the ureter from tenderness due to other causes. On the right side an inflamed ureter is likely to be mistaken for cholecystitis or appendicitis.

In the Pelvis.—The ureters follow the lateral walls of the pelvis in a wide curve whose convexity is outward and backward. As they enter the bladder they are about 4 cm. apart (though the vesical orifices are separated by but 2 cm.).

Through the greater part of their pelvic course the ureters are totally impalpable. Just as they enter the bladder they become palpable in the vaginal vault of the female, in the anterior wall of the rectum in the male. In this location the inflamed ureter may sometimes be felt by bimanual (abdominovaginal) palpation in the female. It cannot be felt by abdominorectal examination in the male unless very greatly enlarged.

Vaginal Palpation.—The ureter passes behind and below the uterine artery at a point from 0.5 to 1.5 cm. lateral to the uterine cervix. Thence its direction is downward, forward, and inward (almost transversely), against and adherent to the anterior vaginal culdesac, to enter the bladder at a point about 2 cm. from the middle line at the junction of the upper and middle third of the vagina.

Hence the sensitive or enlarged ureter may be palpated for over 2 cm. of its course as it runs transversely across the anterior vaginal culdesac. As it reaches the lateral culdesac it is so far distant from the vagina (usually about 1.5 cm.) as to be inaccessible unless greatly enlarged.

Rectal Palpation.—A large ureteral stone impacted at the entrance of the ureter into the male bladder may be felt by rectal palpation. It may be sought at a point about 1 cm. above the prostate and just internal to the seminal vesicle.

The Ureter Catheter.—The ureter catheter, collargol injection, and the wax-tipped catheter give the foundation of diagnosis here, as stated in the preceding section.

PALPATION AND PERCUSSION OF THE BLADDER

The bladder may be examined by abdominal palpation and percussion, by rectal palpation, and by recto-abdominal bimanual palpation.

Abdominal Palpation and Percussion.—The bladder when empty or partially filled can neither be felt nor percussed through the abdominal wall. The bladder of an infant, lying high in the pelvis, must contain at least 150 c.c. before it can be percussed. The bladder of an adult

must contain 300 c.c. or more. To be palpable it must contain about 1,000 c.c.

Percussion of the distended bladder gives a flat note over an area above the pubic bone, the dimensions of which depend upon the distention of the bladder. This area may extend but an inch or two above the pubes or it may rise up to or even above the umbilicus.

Palpation is only possible when the bladder is distended at least half way to the umbilicus. The viscus is felt as a tense sphere rising from the pelvis.

When the bladder reaches the umbilicus and the abdominal walls are lax the tumor in the hypogastrium may be distinctly visible.

Rectal and bimanual palpation.—These methods are described in the following section.

RECTAL PALPATION: RECTO-ABDOMINAL PALPATION

The prostate and, in most instances, the seminal vesicles may be felt by a finger introduced into the rectum.

Preparation of the Examiner.—The examiner may protect his finger by a simple lubrication or by a rubber glove or a specially constructed rubber shield.

The best protector for the finger is a rubber finger cot (a new one for each examination) and a shield for the rest of the hand, made either by winding a gauze bandage about the finger or by tearing a hole in the midst of a small square of absorbent cotton. The finger cot must be lubricated.

In his other hand the examiner holds a piece of gauze with which to wipe the grease from the patient's anus after the examination.

Preparation of the Patient.—The patient's bladder should be moderately distended, preferably with boric acid solution. This is to be urinated out after the examination.

Position of the Patient.—Some prefer that the patient should be upon his back with his knees drawn up, others that he should assume the knee-chest position, others that he should bend over a table with his heels apart, his toes turned in, his knees slightly bent, his back "swayed."

Most patients can be effectively examined in the position last described. With his left hand upon the patient's left shoulder the examiner may exert counterpressure to drive his finger as far as possible up the rectum. The examiner may steady his right hand by bracing the elbow against his right knee.

The Examination.—As the index finger is introduced with its sensitive pulp forward toward the anterior rectal wall, it slips through the two sphincters and enters the rectal cavity above.

Examination of Membranous Urethra and Perineal Body.—With the index finger hooked down and the thumb on the patient's perineum an examination of this body may be made for indurations (cowperitis, peri-urethritis). Just above this the finger in the rectum feels the membranous urethra, an almost imperceptible cord about 2 cm. long, in the median line. Boggy, lumpy, or tender infiltrations may perhaps be felt about it.

Examination of the Prostate.—As the membranous urethra is followed up the bowel it disappears within the apex of the prostate, which is felt beneath the anterior rectal wall.

The normal prostate as felt from the rectum is heart-shaped, with its apex joining the membranous urethra, its base more or less notched in the center, its lateral lobes quite elastic, its central groove between the two lobes more or less marked.

The normal prostate does not project into the rectum. Its lateral lobes are flat rather than bulging. Its outline is a little vague. In order to examine it carefully the finger must be swept over its surface and around its borders. Great experience is required to recognize a normal prostate. So varied are the degrees of sensitiveness and of prominence of the organ, so frequently do we find phleboliths or enlarged glands lying upon it or near it, that the specialist is frequently compelled to confess that he can find nothing abnormal in a prostate that has been pronounced diseased by a less experienced examiner.

The chief signs of a normal prostate are:

The lobes are flaccid, flat, insensitive.

An exquisitely sensitive prostate (like an exquisitely sensitive urethra) may be anatomically normal. A sensitive and tense prostate usually contains pus. A prostate with rounded, tense insensitive lobes is usually hypertrophied, but may be simply inflamed. The relative roundness of the lobes is appreciated by sweeping the finger across them from side to side.

A prostate may be inflamed or enlarged or the seat of neoplasm and yet feel normal to rectal touch.

Cystoscopy and rectal palpation upon a sound in the urethra (p. 315) are of great assistance in diagnosis of carcinoma of the prostate.

There are no indurations in or about the prostate.

Discrete round masses on or near the prostate are usually glands or phleboliths. Indurations within the lateral lobes or projecting toward the seminal vesicles are usually inflammatory; they may be tuberculous or neoplastic. Indurations extending from the prostate into the base of the bladder beyond are invariably neoplastic.

Examination of the Vesicles.—The distinction between the seminal vesicle and the ampulla of the vas is not possible by rectal touch. If

the perineum is deep or the prostate enlarged it may be impossible to insert the finger far enough up the rectum to reach the vesicle.

The normal seminal vesicle is impalpable.

The dilated or inflamed seminal vesicle is felt as an irregular, elongated mass beginning just above the prostate, laterally, and extending upward or upward and outward beyond the reach of the finger. If greatly enlarged the vesicles may meet in the middle line, but usually there is a space about a finger's breadth in width between them. The inflamed vesicle feels doughy or doughy and lumpy.

Examination of the vesicles may sometimes be made easier by counterpressure on the hypogastrium.

A vesicle may be inflamed and yet feel normal to rectal touch.

Examination of the Base of the Bladder.—Neoplasms of the bladder and large stones in the lower end of the ureter may sometimes be felt by rectal touch in the space between the vesicles. Counterpressure on the abdomen is of assistance in this examination.

Abdominorectal palpation sometimes reveals stones in the bladder, but in this respect the examination is likely to be extremely misleading.

PALPATION OF THE PENIS AND URETHRA

Palpation of the Penis.—This presents no peculiar difficulty other than that of identifying obscure circumscribed fibroses in the corpora cavernosa.

Palpation of the Urethra.—The urethra should be palpated upon a sound just large enough to fill it without distention. Careful palpation upon this reveals even the smallest infiltrations in and about the urethral wall.

Only the anterior urethra can be palpated externally. The membranous urethra must be palpated from the rectum. The prostatic urethra can scarcely be palpated.

PALPATION OF THE SCROTAL CONTENTS

Palpation of the Testicle.—The testicle should be palpated by slipping it to and fro between the thumb and the index finger. The chief characteristics to be noted are its size and tension as compared with its fellow, the condition of the epididymis, the presence of hydrocele, and of pathologic conditions in and about the testicle.

The normal epididymis must be carefully palpated many times before the examiner's fingers attain complete familiarity with its usual variations in size, consistence, and attachment to the testicle.

The presence of hydrocele is often a confusing element in diagnosis. Here again familiarity with the tension of a normal testicle and with

the groove that separates it from the epididymis makes the alteration of that tension and the obliteration of that groove by hydrocele immediately recognizable.

Palpation of the Vas Deferens.—The physician should also accustom his fingers to follow the vas from its origin at the tail of the epididymis up to and into the inguinal canal, in order to recognize changes in its size or sensitiveness.

INTERNAL EXAMINATION

The technic of passing urethral instruments and of using the urethroscope, the cystoscope, and the ureter catheter is taken up in the following chapters.

CHAPTER II

URINALYSIS

The foundation of urology is urinalysis. Without a thorough practical familiarity with this art as practiced in the laboratory and in the clinic, no man may expect to diagnose diseases of the urinary organs.

The practice of urinalysis is twofold: laboratory urinalysis and clinical urinalysis.

LABORATORY URINALYSIS

In the laboratory the urine is subjected to tests for acidity, specific gravity, albumin, sugar, indican, etc.; it is centrifuged and the cellular, crystalline, and bacterial content of the sediment noted.

Such an analysis every physician must be competent to perform. There is no special need, therefore, to dwell upon it here, except to insist upon certain points of peculiar interest to the urologist.

THE SELECTION OF THE SPECIMEN

This is of the greatest importance. Unless the patient's general health and the examination of a single specimen warrant the belief that the kidneys are sound a *twenty-four-hour specimen* should, of course, be examined.

But this is not enough. The urologist is chiefly interested in the bacterial and cellular content of the urine. This he wishes to examine without contamination (if possible) by the secretions of the urethra or of the vagina. Hence *the specimen for microscopical examination must be obtained direct from the bladder.* To accomplish this it is best to draw the urine by catheter; though sometimes it is sufficient to have the patient urinate into two glasses (as described below) and to examine the contents of the second glass. This precaution is even more useful for the analysis of the urine of women than of men, though this is not generally recognized.[1] The two-glass test is misleading in women, as the first urine passed does not necessarily clean out all the vaginal pus.

[1] Such special methods of obtaining urine as suprapubic puncture, ureteral catheterization, etc., do not enter into the present discussion.

The old-fashioned method of examining the "morning" and "night" specimens of urine has been generally discarded in favor of the "twenty-four-hour" specimen. Yet in estimating the cause of nocturnal frequency of urination, especially in persons past middle age, a comparative quantitative examination of the urine passed between 9 P.M. and 9 A.M. and that passed between 9 A.M. and 9 P.M. is often imperative. Without it one cannot decide whether nocturnal frequency of urination is due to the polyuria of arterial disease or to prostatism or some other local irritant.

Thus a complete laboratory urinalysis consists of—

1. Chemical and physical examination, qualitative and quantitative, of a "twenty-four-hour" specimen.

2. Microscopical (and bacteriological) examination of the centrifuged sediment of the bladder urine, obtained by catheter or by the two-glass method.

3. In certain cases a comparative examination of "night" and "day" urines.

THE ANALYSIS

The tests that suffice for most cases are:

Physical Tests—
- Reaction.
- Specific Gravity.

Chemical Tests—
- Urea.
- Albumin (quantitative).
- Sugar (quantitative) (acetone, etc., if sugar is found).
- Indican.
- Phosphates.

Microscopical Examination—
- Crystals (differential).
- Blood and pus cells.
- Epithelial cells (differential).
- Casts (differential).
- Bacteria (differential), especially the gonococcus and the bacillus of tuberculosis.

Albumin.—Upon the meaning and importance of the physical and chemical tests we need not dwell, except to insist that the statement so commonly made that "albumin is accounted for by pus" is almost invariably inaccurate, and often fatally misleading. The urine, mixed with about one-fifth of its bulk of normal salt solution and then tested for albumin,[1] never shows more than a trace except under three

[1] For qualitative analysis the acetic-and-heat and the nitric-ring tests are the best. The former is the more delicate if properly performed, thus:

conditions: (1) Nephritis. (2) Acute prostatitis. (3) Hematuria.

So long as there is much blood in the urine, or acute prostatitis, a moderate albuminuria has no great significance, but in the absence of these, and *even in the presence of slight microscopic hemorrhage or of chronic prostatitis, the appearance in the urine of one-tenth of one per cent of albumin (by weight) means nephritis, and if there is pyuria, pyelonephritis.* No amount of pus will liberate so much albumin.

The importance of this fact is great, for the gravest cases of pyelonephritis may evoke no symptoms directly referable to the kidney, and may deliver urine in which *the few kidney casts are overwhelmed in pus and may be overlooked by even the most painstaking search.* In this event the amount of albumin in the urine is the first hint that the kidney is involved.

Epithelial Cells.—The debate as to the ability of the microscopist to identify epithelial cells from the ureter and the renal pelvis has been on for a generation and is still open. The frequent opportunity of examining specimens of urine obtained by the ureteral catheter has of late years educated many men to the point of making this diagnosis with reasonable certainty. A quantity of round and polyhedral cells little larger than a pus cell can only come from the kidney, pelvis, or ureter. A few round, small cells may be desquamated in prostatitis, but these are accompanied by very large round prostatic cells, and usually by squamous bladder cells. Moreover, these prostatic cells may often be eliminated by using the two-glass test or by drawing the urine by catheter.

Accuracy in this diagnosis cannot be learned from a text-book, but must be obtained from a study of specimens obtained by the ureteral catheter.

Bacteria.—Smear, culture and inoculation are all employed in the differentiation of urinary bacteria. Perhaps the most useful device for immediate diagnosis is Crabtree's fractional centrifuging[1] with the high-speed electric centrifuge.

1. The filtered urine (four parts) and salt solution (one part) mixture in a test-tube is held over a Bunsen flame so as to boil only its upper 2 cm.

2. To this is added, without shaking, one or two drops of acetic acid.

3. If a cloud of phosphates is thrown down by the boiling and partially redissolved by the acid, the test-tube is shaken just enough to dissolve the rest of this.

4. The mixture is once more boiled.

5. The upper portion of the fluid is examined by means of a camera obscura. This step is the most important of all. The camera consists of a small box, black inside, with a vertical slit on one side to admit the light, a round hole in the bottom to admit the test-tube, and a flap fixed like an open cover to conceal the source of light (an incandescent bulb is better than daylight). The light striking the fluid suffuses it and plainly shows against the darkness inside the camera an albuminous cloud that would otherwise elude observation.

[1] *Surg., Gynec. and Obstet.*, 1916, xxii, 221.

If the urine contains considerable pus, centrifuge for one to two minutes at the lowest speed. The bulk of the pus and detritus will be thrown down in a heavy sediment leaving a somewhat cloudy urine above containing a few pus-cells and the majority of the bacilli. Decant the urine into a clean tube, discard the sediment, and centrifugalize the urine at high speed *until it is clear.* This step requires 15 to 30 minutes. The urine may be then decanted and the tube containing the sediment refilled with partly clarified urine and replaced in the centrifuge. In this way the contents of two or more tubes of urine may be concentrated into a single small sediment. Pour off the urine, invert the centrifuge tube on a towel and drain off the last drops. A fairly dry small sediment will be obtained which can be removed with a loop, and cover-glass preparations made, or cultures planted.

In those urines which contain but little pus, experience has shown that preliminary centrifugalization is unnecessary. The important step in the procedure is to centrifugalize the urine *until clear* to ensure deposit of the bacilli.

Special precautions are required for—

1. Diagnosis of the gonococcus (p. 108), and
2. Diagnosis of the bacillus of tuberculosis (p. 424).

CLINICAL URINALYSIS

On the score of common knowledge we have skimped the description of laboratory analysis to make room for detailed description of the special knowledge required for a competent clinical urinalysis, without which the urologist is hopelessly at sea.

Clinical urinalysis consists in looking at the urine and interpreting what we see therein. It suggests the nature and quantity of substances held in suspension in the urine. It suggests, also, in many instances, the part of the urinary tract from which these substances are derived. But *it is by no means infallible, and its findings must always be confirmed by laboratory urinalysis and by a physical examination of the patient.*

These propositions are fundamental. They seem to leave a very small place in the diagnosis for this clinical test whose only function is to suggest and not to prove. Yet, practically speaking, clinical urinalysis is employed far more constantly than the laboratory tests. At the first examination of a case it often—very often—gives the suggestion that leads ultimately to correct diagnosis, and in subsequent examinations it is our chief means of judging the progress of the case.

At the patient's first visit, therefore, the urine should be carefully inspected before it is submitted to laboratory tests, though the inferences made from inspection should not be acted upon unless the laboratory confirms them. At subsequent visits, on the other hand, clinical examination of the urine by inspection is always imperative, while laboratory examination is only required from time to time.

TECHNIC OF CLINICAL URINALYSIS

It is by no means a waste of time to describe precisely what is meant by "looking at the urine." This does not mean looking at it as it lies in the bottom of an opaque vessel; it does not mean looking at it after it has shaken about in a bottle in the patient's pocket for hours; it does not even mean glancing at it casually in a dirty glass and by an imperfect light. What it does mean is this:

Let the patient present himself for examination at least two, and if possible three or four, hours after his last urination. Let him pass into a large, clean tumbler (a pint glass is the best size) about 50 c.c. of his urine, the rest into a second glass.

Now examine the contents of these two glasses against a strong light. No speck or cloud in them is too insignificant to be noticed. View them intently and begin to draw tentative conclusions, recognizing that these conclusions are not final, but only important hints. "This is a foreign body." "This is a shred which, to judge by its size, comes from the anterior urethra. There is a speck of blood adherent to it." "This haze is opalescent, and, therefore, probably crystalline or bacterial." "This swirl of fresh blood still undistributed is more probably vesical or prostatic."

Such are a few of the thousand and one inferences drawn by the expert examiner. By making such inferences and confirming or refuting them in the laboratory or by physical examination, one soon learns to make rapid and accurate inferences from data imperceptible to the inexperienced eye.

The accuracy of these inferences may be increased by:

1. The acetic acid test.
2. The comparison of the contents of the first and second glass (for men only).
3. Comparison with these of a third glass of urine (for those cases in which the two-glass test might prove misleading).

The Acetic Acid Test.—The substances held in suspension in the urine are organic and crystalline. The former (pus, blood, bacteria, etc.) form the object of the clinical examination, while the latter (crystals), though of considerable importance in the general diagnosis, are only confusing here. Their presence simply obscures the undissolved organic content of the urine.

Now of the various crystals that may cloud the urine, the earthy phosphates are the commonest and the most important. *Urates* and *uric acid* are rarely seen in any quantity in freshly passed urine (and their reddish color distinguishes them), *oxalates* or *cystin* scarcely ever

occur in such quantity as to cloud the urine,[1] but the phosphates are common and readily soluble by acidulation of the urine.

Therefore, if examination of the urine in two glasses shows that both are cloudy (for the phosphatic cloud appears in both urines[2]) the glass containing the second urine is held against the light and a few drops of acetic acid poured down its side. If phosphates are present, there follows instant effervescence (from the breaking up of carbonates that are always associated with phosphates) and clearing of the urine.

This clearing may be interfered with in only two ways, viz.: by the presence in the urine of insoluble substances (crystalline or organized), the nature of which must be determined by microscopic analysis, and by the presence of copaiba in the urine. The urine of a phosphaturic patient taking copaiba clears only for an instant, and then becomes cloudy again, the copaibal cloud being only a little less opalescent than the phosphatic cloud which it replaces.

When, therefore, we know from previous microscopic analysis the nature of the insoluble substances in a patient's urine, and know, also, that he is not taking copaiba, the acetic acid test is used as the simplest

[1] I have several times seen an oxalate cloud, once a cystin cloud. They produce the same opalescent haze as do phosphates or bacteria, and are distinguishable only by the microscope.

[2] When the phosphates are in great excess they are not distributed evenly throughout the urine but, having settled in the bladder, are most concentrated in the last drops. In extreme phosphaturia this concentration of crystals in the last drops is so marked that the patient can occasionally squeeze from the urethra little gritty masses of phosphates left there after urination is complete.

The characteristics of this *phosphaturia,* as it is called, are the following: It occurs almost exclusively in youth, between the age of fifteen and thirty-five. It is apparently due to a functional disturbance in assimilation, and is therefore commonly seen in young persons who work with their heads rather than with their hands, is often associated with functional dyspepsia, and like this is most marked at periods of mental stress. It never causes stone or inflammation of the urinary passages, and its association with pus in the urine is purely accidental. Its chief clinical characteristic is its sudden appearance and disappearance; at one micturition the urine is milky with phosphates, at the next absolutely sparkling and clear. Its prognosis is good; it gradually lessens with age; it does no harm. The sexual neurasthenic of course looks upon it with horror, and for the mental relief of such persons treatment of the phosphaturia is required.

First, one should insist that the phosphaturia is harmless in itself and only a sign of functional derangement. Secondly, one must insist upon a strict régime of diet and exercise appropriate to the existing nervous or digestive disturbance. Thirdly, one must remember that a direct attack upon the phosphaturia by drugs is usually a failure, and if successful is only of temporary efficacy. Hexamethylenamin, salol, benzoate of soda, and other urinary acidifiers have a reputation beyond their merits. Ten drops of dilute hydrochloric acid before each meal I have found more efficacious than anything else, but our main reliance is hygiene, especially as to diet and exercise.

method of removing a chance phosphatic cloud, as a routine preliminary to the clinical examination of the urine.

Comparison of the First and Second Urines.—Having tested for phosphates by the addition of a few drops of acetic acid, and dissolved these, if present, by adding an excess of this acid, the physician holds the two glasses into which the patient has passed his urine against the light and compares their contents.[1]

The first urine passed is the urine as it lay in the bladder, plus what it has swept from the urethral walls.

The second urine passed is the urine as it lay in the bladder, without admixture of anything gathered from the urethra during its exit.[2]

This rule has but two exceptions, as follows: (1) If the insoluble substances suspended in the bladder urine are very dense they may settle to the bottom as the urine lies in the bladder and come away chiefly with the last drops of urine. The substances which fall within this exception are blood-clots, crystals (usually phosphates), and pus, when present in great quantity (such as usually comes from pyonephrosis).

(2) The second urine may also be contaminated by whatever may be squeezed from the urethral wall during the "piston stroke" muscular spasm that clears the urethra of the last drops of urine. Under this exception come pus squeezed from the prostatic ducts (or from a prostatic abscess) when the prostate is gravely inflamed, and blood squeezed from the bladder neck (or from the adjoining surface of the bladder or urethra) when this is acutely inflamed, ulcerated, or the seat of neoplasm.

These exceptions amount clinically to this:

[1] Comparative examination of the two urines is of no interest if the patient is a woman since the differences in them are chiefly accounted for by the vaginal secretion in the first glass. It is scarcely necessary to add that examination of a third glass is equally inapplicable to women.

[2] This elementary physical fact that the first fluid flushes the outlet and the second comes clean from the tank would scarcely require explanation were it not for the fact that so many physicians believe that the first urine passed shows the contents of the anterior urethra, the second those of the posterior urethra. This fundamental error is fostered by the clinical fact that the contents of the posterior urethra are often mingled with those of the bladder before urination. In this event the first urine passed contains what it sweeps from anterior and posterior urethra during the urination, plus what has entered the bladder from the posterior urethra between urinations, while the second urine contains only what has flowed back into the bladder from the posterior urethra, between urinations (supposing the bladder and kidneys add no contamination). Thus the comparison of the two urines may under certain conditions show one the content of the anterior urethra, plus that of the posterior urethra, the second only that of the posterior urethra, and under these special conditions the first urine does roughly represent the anterior urethral washings, the second urethra the posterior. But to step from this particular to a broad generalization is inaccurate and misleading both in theory and in practice.

The two-glass test may mislead in the presence of bleeding or of active suppuration in prostate or kidney.

The Three-glass Test.—For such cases a still further hint (none of these tests is proof) as to the conditions present may be obtained by making the patient pass his urine in three glasses instead of two without interrupting the flow of urine in transferring from one glass to another. The three specimens thus obtained represent:

1. Bladder urine (less sediment), plus washings of urethra.
2. Bladder urine (less sediment).
3. Bladder urine, plus sediment or substances expressed by "piston stroke."

Yet this test is very rarely employed, since its disclosures are confusing (failure to determine the derivation of the contents of the third glass), and require verification by other methods of examining prostate, bladder, and kidneys, which methods are themselves far more accurate than this three-glass test.

Another three-glass test frequently employed as an aid in the diagnosis of chronic prostatitis or vesiculitis is the following: The patient urinates into two glasses, but retains some urine in the bladder. The physician then massages the prostate or the vesicles (or both), and the patient then passes into a third glass the remaining urine, carrying with it the expressed secretion from the glands massaged.

This test is accurate only in case the second urine is quite clear, and is necessary only when it is impossible to squeeze from the suspected gland enough secretion to make it appear at the meatus, and when the instrumentation necessary to fill the bladder with a clean solution before massage is impracticable.

Other Tests.—A variety of tests involving the use of a greater number of glasses have been devised for the specific purpose of locating inflammation in the anterior or posterior urethra exclusively. Their complexity is such that they are of no practical value.

THE ESSENCE OF CLINICAL URINALYSIS

The results to be expected from any of these methods of clinical urinalysis are directly proportionate to the skill of the examiner. The essence of the test is his ability to distinguish at a glance slight variations in the amount and quality of pus, blood, or shreds present. Thus clinical urinalysis is of the greatest use for the prognosis from day to day. As a diagnostic test of the nature of disease it is at its weakest.

CHAPTER III

URETHRAL INSTRUMENTS: THEIR ASEPSIS

URETHRAL INSTRUMENTS

The axiom that a good workman does not complain of his tools implies in him appreciation and possession of adequate instruments. The urologist, therefore, must thoroughly understand the nature, the care, and the use of urethral instruments.

In the selection of urethral instruments no two authorities can be expected to agree. Thus the specialist can afford to employ many instruments which would be useless in less expert hands. But certain instruments are required by every man wishing to do good urological work. All of these we believe to be included in the following list. The latter may be enlarged according to the fancy of the physician; on the other hand, it may be diminished by omitting the instruments bracketed.

A set of conical sounds. (No. 15 to 32 French.)
A set of olivary-tipped conical woven bougies. (No. 10 to 20 French.)
[A set of bulbous bougies.]
Kollmann dilators.
Filiform bougies.
[A set of tunneled sounds, catheters and filiforms.]
[A set of Janet steel sounds and filiforms.]
Soft-rubber catheters. (No. 15 to 20 French.)
Woven olivary "natural curve" catheters.
[Indwelling catheters.]
An elbowed obturator.
Urethroscopes and attachments.
Cystoscopes, ureteral catheters, etc.
[Silver catheters.]
[Stone searcher.]
A 200 c.c. syringe.
Urethral injection syringes.
An instillator. (Keyes, Bangs or Guyon type.)
Nozzles and apparatus for anterior urethral irrigation.

SCALES

The scale for grading the caliber of urethral instruments was first accurately fixed in France, where two scales are at present in use—the Charrière (commonly known as the French scale) and the Béniqué. Other scales are the English and the American.

Of late years the tendency in this country, as well as in England, has been to adopt the French scale as the most convenient, while in France itself there is a tendency to replace the old French (Charrière) by the new Béniqué scale. Although Dr. Van Buren, senior author of the parent edition of this work, was very tenacious of the American scale—which, indeed, was born in his office—the almost universal adoption of the French scale since his time has led us to drop the American in favor of the French scale.

The French (Charrière) scale indicates diameters in $\frac{1}{3}$ mm. No. 1 has a diameter of $\frac{1}{3}$ mm., No. 2 a diameter of $\frac{2}{3}$ mm., and so on. From this scale, therefore, the diameter of an instrument may be determined by dividing its number by 3. A No. 30 sound has a diameter of 30 mm. $\div$ 3 = 10 mm.

The Béniqué scale indicates diameters in $\frac{1}{6}$ mm. It numbers instruments twice as high, therefore, as the Charrière. A No. 30 French sound is a No. 60 Béniqué. B. = F. $\times$ 2.

The American scale indicates diameters in $\frac{1}{2}$ mm. 30. F. = 60 B = 20 A. A. = $\frac{2}{3}$ F.

The English scale follows no rule, but its numbers are generally about 2 less than the American. Thus, 30 F. = 60 B. = 20 A. = 18 E. E. = (A. or $\frac{2}{3}$ F.) — 2.

SOUNDS AND BOUGIES

A metal instrument for urethral exploration is commonly termed a *sound* (though a bulbous bougie may be metallic), while a flexible instrument (made of woven silk and varnished) is called a bougie.

The best woven instruments are made in France. In order to spare the patient's meatus, I have all my sounds above 24 F. size made with double taper (Fig. 1).

American custom favors the use of the single-curve sound (Fig. 1), while European custom favors the double-curve or Béniqué instrument (Fig. 6). After many years' use of the former, I have discarded them in favor of the latter.

Conical Woven Bougies (Fig. 2).—These should be olivary tipped. Inasmuch as they are used to dilate strictures up to the point where steel sounds may be used, one should possess a complete set from 10 to 20 French size. The neck of the instrument should be quite flexible.

Bulbous Bougies (Fig. 3).—Bulbous bougies may be flexible or metallic. The best French makes of flexible bougies are almost as durable as and more useful than the metallic instruments.

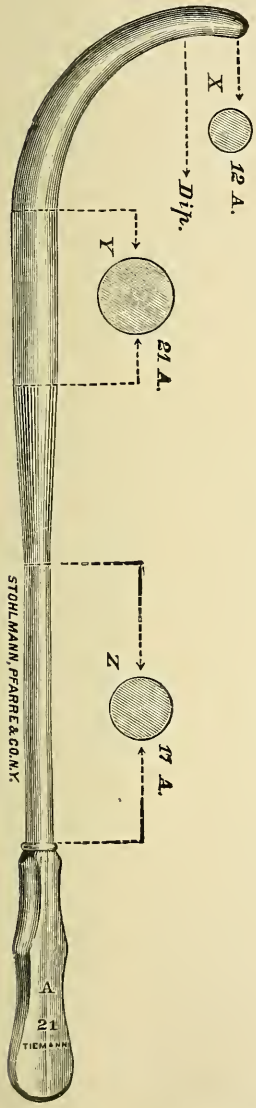


Fig. 1—Double Taper Sound.

Fig. 2.—Olivary Bougie.

Fig. 3.—Bulbous Bougie.

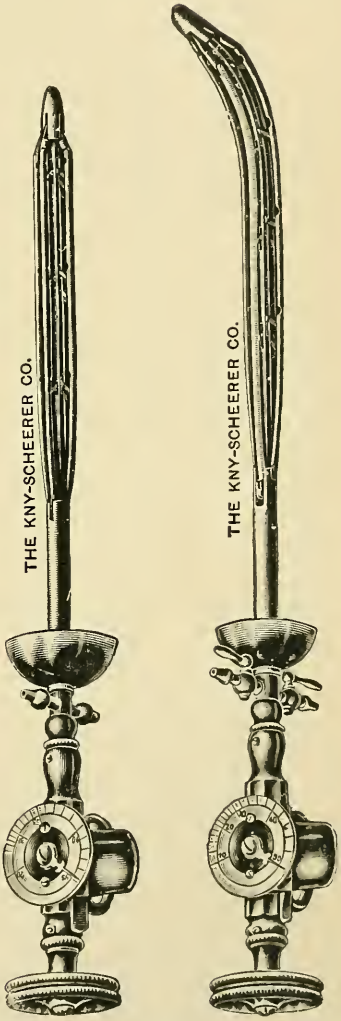


Fig. 4.—Kollmann Dilators.

Kollmann Dilators (Fig. 4).—These are useful for dilating the urethra while sparing the patient the insignificant operation of meatotomy, and also to carry dilatation to great lengths. The Oberlaender, Frank, and Thompson dilators are inferior to the Kollmann.

The best models of these dilators are made of pure nickel by Gentile in Paris. The nickel does not rust, and the instrument may therefore be sterilized by boiling.

This dilator is made in several designs, some of which have irrigating attachments. The two types illustrated are the ones generally employed.

Filiform Bougies (Fig. 5).—Filiform bougies are made of whalebone or of woven silk.

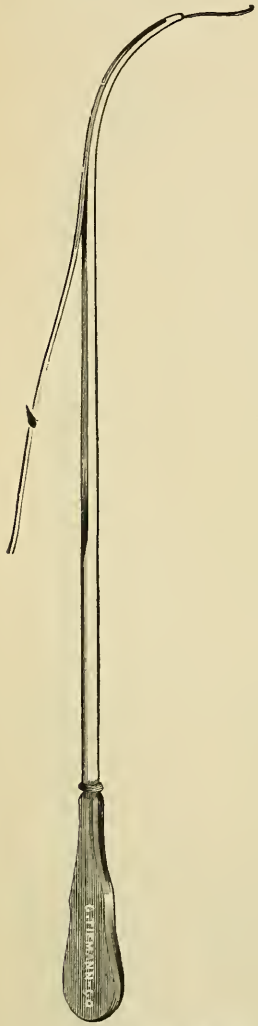


Fig. 5.—Whalebone Filiform and Tunneled Sound

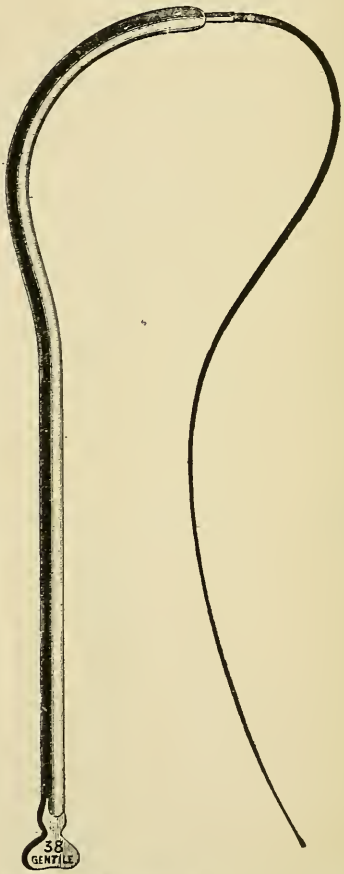


Fig. 6.—Woven Filiform and Janet Sound.

Their average size is 3 French; they should be olive tipped. The choice between whalebone and woven filiforms is largely a matter of taste. Both are fragile, liable to break off in the urethra, and therefore *old, frayed, and ragged filiforms should be instantly discarded.*

Inasmuch as filiforms are used chiefly as pathfinders for larger

instruments, the choice of filiforms depends largely upon the instruments which are to follow. Two combinations are possible, viz.: the whalebone filiform and the tunneled sound (Fig. 5), the French woven filiform and the Janet sound (Fig. 6).

The excellence of our whalebone instruments and the difficulty of obtaining satisfactory woven filiforms, have made the whalebone-tunneled-sound combination the popular one in this country, in spite of its mechanical inferiority.[1]

The combination of a good woven filiform and a Janet sound (a set of these should contain at least every alternate number from 10 to 20 French) is better, both because of its smoothness and because the filiform may be tied into the urethra until, by repeated dilatations, a sufficient size shall have been attained to insure the patency of the stricture.

CATHETERS

A good catheter must be smooth both inside and out, boilable and durable. Two special features of importance are the "round-edged" or "velvet" eye, now universally employed, and the funnel end, which is universally employed in Europe and conspicuously neglected by American manufacturers.

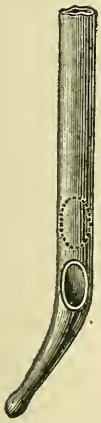


Fig. 7.—Woven Olivary Catheters.

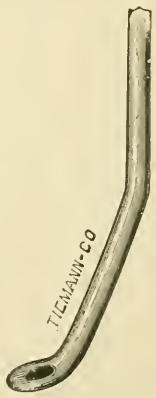


Fig. 8.—Double-elbowed Catheter.

Soft-rubber Catheters. — These commend themselves for general use by their flexibility. Of all urethral instruments they can be passed the most gently. The choice of sizes lies between 15 and 20 French. An instrument larger than the latter size is unnecessary, while most instruments of the former size have so small a caliber that they transmit fluids very slowly, and are obstructed by even a small amount of viscid pus or blood clot. Yet these smaller instruments pass more comfortably through a sensitive urethra.

Woven Olivary Catheters (Fig. 7).—These are useful to penetrate a small orifice (stricture, spasm), while *woven elbowed catheters* introduced with the point directed upward, ride over obstacles on the urethral floor (false passage, hypertrophied prostate). *Woven double-*

[1] The rough eye of the tunneled sound scratches the urethra, slips with difficulty over the filiform, and bends or even breaks this in the urethra, complicating the already difficult situation by the addition of a false passage or a foreign body.

elbowed catheters (Fig. 8) ride over certain prostatic obstacles which the single-elbowed instruments will not surmount. *Woven olive-tipped elbowed catheters* (Fig. 7) combine the advantages of the olivary and elbowed instruments, and are more generally useful than either. But sometimes a spasmodic or congested urethra admits a blunt instrument more readily than an olive-tipped one, just as *occasionally* a straight instrument may pass where an elbowed one will not. *"Natural curve"*

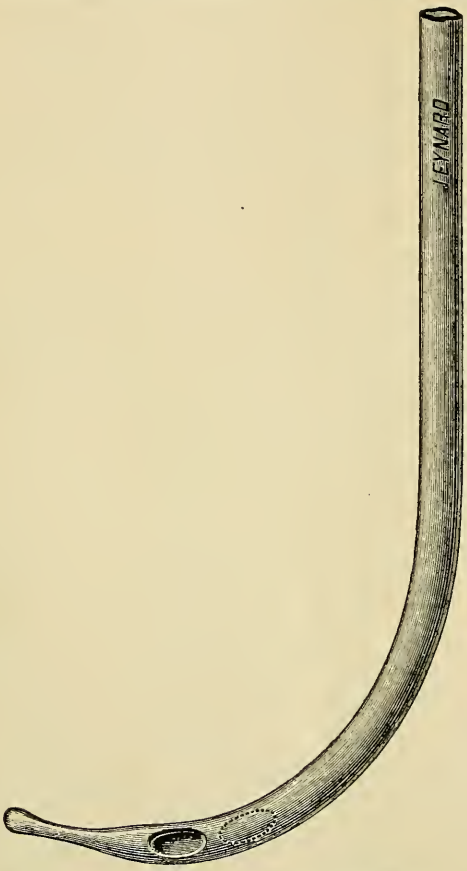


Fig. 9.—Natural Curve Catheter.

Fig. 10.—Guyon Obturator.

catheters (Fig. 9) are more generally useful than any other type of woven catheters. I employ them almost exclusively. Since woven instruments have a relatively larger caliber than soft-rubber ones, they may be employed in rather small size (15 to 17 French), and one should possess very small woven instruments (10 French) to pass a tight stricture or a greatly congested prostate.

Indwelling Catheters.—These are not necessary instruments, and since they have to be made of a relatively perishable mixture they are

usually stiff and useless before the occasion for their use arises. Indeed the indwelling catheter usually irritates the male. It is therefore used almost exclusively in women.

For such prostatic obstacles as cannot be surmounted by even the "natural curve" catheter, various ingenious devices have been employed. The *silver catheter,* with a long, "prostatic" curve, is a dangerous instrument in inexpert hands, which may rarely be passed with safety, even by an expert, more than once or twice in a given case. A very satisfactory substitute is the *elbowed or Béniqué curved obturator* of Guyon (Fig. 10). This, when slipped into a rubber or woven catheter, converts it temporarily into a stiff instrument, with the great advantage that the obturator may be withdrawn, leaving an indwelling, soft catheter in the urethra.

Silver Catheters.—Silver catheters, tunneled or threaded, for filiforms, are useful in an emergency to relieve stricture retention. The silver catheter curved like a sound, that is found in every pocket case of instruments, is inferior in every respect, except that of portability, to a woven instrument.

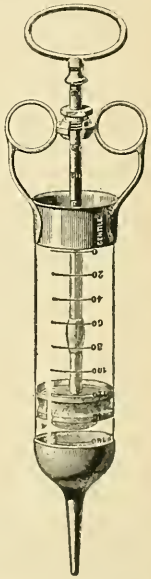


Fig. 11.—Janet Syringe.

SYRINGES AND NOZZLES

One of the most difficult to obtain of all urological instruments is a good syringe of large capacity.

The Janet Syringe (Fig. 11).—This is an excellent instrument. These syringes hold 125 to 150 c.c. of fluid. When not in constant use, the rubber piston must be kept out of the barrel.

Quarter-ounce Blunt-nozzled Glass Syringes.—These are necessary for injections into the anterior urethra.

Instillators.—Instillators of the Keyes[1] pattern (Fig. 12), as at present constructed, consist essentially of small-caliber, short-curve silver catheters, with the eye in the tip. These are fitted to thread or slip on any hypodermic syringe. The instruments are thus readily sterilized and portable. The straight part of the shaft should be six inches long, in order to keep its outer end clear of the glans penis.

ANTERIOR URETHRAL IRRIGATION

The apparatus for anterior urethral irrigation consists of a tank (preferably of glass, and so hung that it may be readily raised and

[1] The Ultzmann syringe, of which the Keyes is a modification, is a very clumsy instrument. The Guyon instillator, a capillary woven catheter, has never found favor in this country. Modifications of the Keyes instrument have been made by Cabot, Bangs, and others.

lowered), a connecting tube, a nozzle, and means of interrupting the flow of fluid through the tube.

The tank forms part of the urological equipment. Of nozzles and interrupters there is a great variety. The simple, blunt-pointed glass

Fig. 12.—Keyes Instillator.

nozzle and a cut-off with protecting bell, form the most familiar apparatus.

URETHROSCOPES, CYSTOSCOPES, ETC.

A description of urethroscopes, cystoscopes, etc., is more appropriately reserved for a special chapter. The same is true of the operative armamentarium.

ASEPSIS IN URETHRAL EXAMINATION

However infected the bladder into which a catheter or sound is to enter, that catheter must be scrupulously aseptic. The days when surgeons may joke about the old gentleman who keeps his catheter inside his hat and spits on it by way of lubrication are past.[1] Even when the bladder is infected asepsis is imperative, to prevent an increase of that infection.

The asepsis of catheterism, using the term broadly to cover every passage of an instrument into the urethra, implies three requirements, viz.:

1. Asepsis of the physician's hands.
2. Antisepsis of the patient's urethra.
3. Asepsis of the instrument introduced.

[1] Yet such old gentlemen are still encountered in practice. But the apparent immunity which some of them enjoy is due in part to the fact that their bladders are already so severely infected that a little saliva makes them no worse. And though their immunity may for a time prevail, in the end they become more and more infected and die of sepsis. The need for scrupulous asepsis is not because every dirty catheterism causes infection, but because a single dirty catheterism *may* cause infection of the gravest sort.

ASEPSIS OF THE PHYSICIAN'S HANDS

It is not possible to require of the physician about to pass a catheter that he sterilize his hands as if for a surgical operation, or wear sterile rubber gloves. Such cleanliness is only required for such prolonged and delicate operations as cystoscopy. But the physician's hands should be well washed with soap and water, and, *having washed his hands, the physician should act as though they were still dirty;* i. e., he should not touch that part of the instrument that is to enter the deep urethra. This is a simple rule, a necessary rule, a universal rule. *The last three inches of the instrument should not be touched by anything except sterilized lubricant from the time it is sterilized until it enters the urethra.*

ANTISEPSIS OF THE PATIENT'S URETHRA

The Uninflamed Urethra.—It has been amply proven[1] that, though the posterior urethra is sterile, the normal anterior urethra may harbor quite an indefinite number and variety of pathogenic microörganisms. But, on account of the mechanical cleansing of the urinary stream, these are almost exclusively confined to the balanitic portion of the canal. Yet it is not unusual to find bacteria in the bulb of the uninflamed urethra, though it is most unusual not to find them in the terminal inch (p. 166).

Moreover, the preputial cavity swarms with bacteria. Hence has arisen the practice of washing the glans penis and flushing the terminal inch of the urethra with boric acid solution before introducing any instrument. Though such washing and flushing is scarcely more effective than that of the urinary stream, and might, therefore, be omitted, except in case the danger of infection is unusually great, i. e., in cystoscopy, catheterism for aseptic retention, and tying in an indwelling catheter, perfect technic requires that this washing and flushing always precede introduction of urethral instruments of whatever description.

The Inflamed Urethra.—When the urethra is acutely inflamed, the passage of instruments is permissible only for the cure of that inflammation, or for the relief of retention of urine. In either event the mechanical damage done by any added manipulations outweighs their virtue. No special effort should therefore be made to clean the canal: the glans and meatus should be well washed.

Chronic urethritis is no bar to the passage of instruments. These may be used either for the treatment of urethritis or for the diagnosis or treatment of coexisting conditions.

[1] Lustgarten and Mannaberg, *Vierteljahresschrift f. J. Derm. u. Syph.*, 1887; Rovsing, "Die Blasenentzündungen," 1890; Wassermann and Petit, *Guyon's Annales*, 1891, ix, 371; Melchior, "Cystite et infection urinaire," Paris, 1895.

In the former case the instrumentation (catheterism) habitually carries with it its own antisepsis (injection).

In the latter event (passage of sound, cystoscope, etc.), not only may this instrumentation not directly imply antisepsis, but it may directly imply considerable trauma to an infected canal. Therefore it is necessary to precede the instrumentation by a soap-and-water and bichlorid wash of the glans and adjoining tissues, and a thorough irrigation of the meatus, and even, in some cases, of the whole urethra, with silver nitrate 1 : 4,000, or oxycyanid of mercury 1 : 4,000. But the urologist must not confide too much in what is at best but a superficial and incomplete antisepsis of the anterior urethra. The danger of infection is far more closely related to clumsiness or roughness in passing the instrument than to preliminary urethral antisepsis. *Every surgical operation must be cleanly; but every urethral manipulation must also, and above all, be gentle.*

The dangers of urethral instrumentation are local (exacerbation of urethritis, prostatic or periurethral abscess), and chiefly to be avoided by discretion in the choice of and gentleness in the passage of the instrument; or general (urethral chill, systemic gonorrhea, urinary septicemia), and chiefly to be avoided by antisepsis, to a less degree by gentleness.

This antisepsis, of which the principles and practice are discussed in Chapter XXXVII, consists in:

Hexamethylenamin before,
Gentleness during, and
Local antisepsis after instrumentation.

The hexamethylenamin may often be omitted with impunity, and, since it implies administration of the drug for forty-eight hours before instrumentation, it is often neglected. But there is no excuse for neglecting to be gentle or for omitting some form of antisepsis after instrumentation. Even when the temper of the urethra is well known the omission of a postinstrumental antisepsis may unexpectedly excite a sharp chill.

The usual postinstrumental antisepsis consists of an instillation of nitrate of silver or an irrigation with some silver salt or with permanganate of potassium.

ASEPSIS OF THE INSTRUMENT

In any case, the instrument introduced must be aseptic. By this we mean that the whole instrument must be rendered aseptic,[1] and

[1] The flaming of a metal instrument whereby the beak and shaft are sterilized, but the dirty handle remains uncleansed would be perfectly permissible were it not a dangerous habit to permit the least relaxation of asepsis. Moreover, the convenience of flaming compared to boiling is quite imaginary.

must so remain except for its contact with the physician's hands, which, as already stated, should not touch its terminal three inches.

This asepsis implies four conditions:

1. Aseptic lubrication.
2. Antisepsis immediately after using.
3. Aseptic preservation.
4. Antisepsis before using.

Lubrication.—The lubricant employed for urethral instruments should be soluble in water. Oily lubricants, such as vaselin or olive oil, may be perfectly sterilized by boiling, but they can only be removed from the instrument with great difficulty, if at all. Hence, an instrument covered by an oily lubricant is much more difficult to resterilize than one which is mechanically clean. Albarran has shown that a clean catheter may be sterilized by boiling for ten minutes, while an oily catheter must be boiled half an hour.

Among the substances in common use as lubricants may be mentioned glycerin and boroglycerid. Guyon uses a mixture of equal parts of water, glycerin, and soap powder. Various combinations of Iceland moss, sterilized in formalin, are sold under different trade names. But the best lubricant I know has the following formula, modified by Dr. E. Wood Ruggles:

Dissolve 1 cm. of oxycyanid of mercury in 200 c.c. of hot sterile water; add 35 c.c. of glycerin and water enough to make 350 c.c. Let this mixture cool; then add 10 to 15 gm. of powdered gum tragacanth. Let this stand until it becomes a homogeneous mass, a process which takes several days, but may be hastened by occasional stirring to break up the lumps. The amount of tragacanth employed depends upon the consistence of this substance, which varies considerably.

This lubricant may be put up in sterile paint tubes. Its quality depends upon the employment of precisely the right amount of tragacanth.

The Instrument.—The practice of asepsis for urethral instruments is approximately that of general surgery, and requires that:

1. The instrument should be so constructed as to be readily cleansed. It should be as free as possible from joints, crannies, etc. It should be in good condition, free from rust or cracks.

2. It should be sterilized by boiling. Strong (almost saturated) sodium chlorid solution is less destructive than plain water.[1]

3. It should be washed clean and sterilized immediately after using, kept sterile (if possible), and resterilized immediately before using.

4. Instruments for use in "pus cases" should be kept entirely distinct from those for use upon "clean cases."

[1] Krotoszyner (*Medical News*, 1904, lxxv, 406) makes this suggestion and also suggests a saturated solution of ammonium sulphate for woven instruments.

Unfortunately the one instrument that is the least subject to any of these rules, viz., the cystoscope, is the very instrument that preëminently requires sterilization. The special measures required for sterilization of cystoscopes are, therefore, considered elsewhere (p. 51).

All other instruments should be subjected to the following:

1. Soap and water wash, inside and out, immediately after using. Then rinse in water and boil for at least fifteen minutes in strong salt solution.

2. Keep the instruments in an instrument case, the interior of which is kept at least relatively clean by formalin (trioxymethylene) pastilles, or a formalin lamp.

3. Unless the instrument has been recently used and its asepsis assured, always resterilize by boiling for fifteen minutes immediately before using.

4. Use a separate set of catheters at least for gonorrheal cases.

The special variations and precautions in the technic of sterilization required by various instruments are the following:

Dilators and Other Complex Instruments.—Dilators, urethrotomes, and such complex instruments should be made of pure nickel; otherwise it is almost impossible to keep them from rusting. If nickel-plated, they must be sterilized like the cystoscope (p. 51).

Woven Instruments.—It is the accepted tradition that woven instruments cannot be boiled, and it is current practice to sterilize them by formalin vapor. But I have for several years been boiling all my woven instruments, and can assert that they stand boiling perfectly well if they are of standard French manufacture (any one of half a dozen firms) and if their sterilization is surrounded with a few simple precautions.

When a woven instrument is boiled, its varnish becomes utterly soft, and therefore cracks if any other instrument rests upon it, or if it is bent before it has cooled. Therefore it must lie perfectly straight in the sterilizer, touching neither the sides nor the ends of this, and with no other instrument resting upon it. More important still, *after the instrument has been boiled it must not be touched* until it has been cooled off, either by lifting it from the water on an automatic platform or by pouring in cold sterilized water.

ASEPSIS OF OTHER INSTRUMENTS AND OF SOLUTIONS

In order to permit clean urethral work, the wall tanks, syringes, and other containers, as well as the solutions, must be sterilized quite as carefully as the urethral instruments themselves.

Tanks, Syringes, Etc.—All containers are best sterilized by boiling immediately before each clinic or office hour. Wall tanks may, however, be left filled with an antiseptic solution between times. It is necessary

to have at hand a pan of boric acid solution in which to cool sounds after boiling, and to rinse instruments that have been sterilized by formalin. It is my custom to keep all syringes, hypodermic needles, mixing rods, instillator catheters, in a 10 per cent formalin solution, supersaturated with borax.[1]

It is peculiarly important that all containers should be kept from any contact with urine. The measuring glass for urine should, therefore, be of a peculiar shape, readily distinguishable from that employed for the solutions.

Solutions.—All solutions should be made up fresh, warm, and aseptic. The chemicals are kept in a certain stock (preferably solid) form (p. 211), and the water must be both sterile and warm. The urologist should have two boilers, containing a gallon or two apiece, each one of which should be boiled every alternate day, so that hot and cold sterile water are at hand to be mixed in any desired proportion.

For him who depends upon a central supply of sterilized water (e. g., a boiler in the operating room), it is more convenient to keep cold sterile water in a glass reservoir and hot water in a metal reservoir, covered with asbestos.

SUMMARY OF INSTRUMENTAL ASEPSIS

For Cystoscopes.—Cabinet containing formalin lamp and desiccation apparatus. Clean well before and after sterilization.

For Other Instruments.—Boil for fifteen minutes. Use soluble lubricants, and boil again after use. Keep in formalin cabinet.

For Solutions.—Hot and cold boiled water in boilers or tanks. Containers boiled daily. Mixing rods, syringes, etc., boiled and kept in sterile solutions.

[1] Steel instruments do not rust in this solution if enough borax is kept in it actually to supersaturate it and leave a little undissolved at the bottom of the jar. As the borax dissolves very slowly what may appear enough when the solution is first made up proves insufficient a day or two later.

CHAPTER IV

THE PASSAGE OF URETHRAL INSTRUMENTS

The successful introduction of an instrument into the urethra depends upon the skill of the operator and his comprehension of the obstacles that may defeat the operation.

ANATOMY OF THE URETHRA

The urethra is the outlet of the bladder. It commences at the bladder neck, but embryologically and anatomically that part of the floor of the bladder known as the trigone (i. e., the triangular space between the orifices of the ureters and the urethra) belongs to the urethra, and will be so considered.

The urethra tunnels the upper part of the prostate, perforates the triangular ligament, and terminates at the end of the penis. Its outer

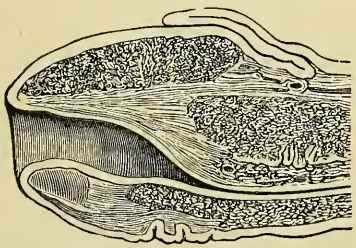


Fig. 13.—Sagittal Section through Glans and Fossa Navicularis. (Cruveilhier.)

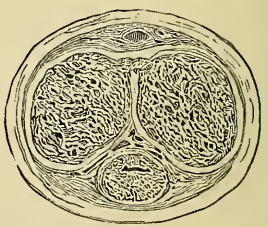


Fig. 14.—Transverse Section of the Penis. (Cruveilhier.)

opening is known as the *meatus,* or the *meatus urinarius.* The urethra is divided naturally into two parts, the *anterior* and the *posterior urethra,* by the triangular ligament, the anterior urethra lying external to the anterior layer of that structure, and the posterior urethra being the continuation of the canal backward into the bladder. The anterior or spongy portion of the urethra is again subdivided into four parts, the navicular (or the fossa navicularis, Fig. 13), penile (Fig. 14), scrotal, and bulbous or bulboperineal. The posterior urethra is subdivided into the membranous, the prostatic, and the trigonal portions. It is much more accurate to speak of a lesion, such as a foreign body or a

stricture, as being at the penoscrotal angle or in the bulb, than to say it lies at a depth of 4 or 6 inches, for not only does the length of the urethra vary according as the penis is erect or flaccid and in disease (hypertrophy of the prostate), but the urethral length, the urinary distance, varies widely in different healthy individuals (p. 37). The urethra is always a closed canal throughout its whole course, except when distended by some foreign substance.

The *mucous membrane* of the urethra consists of a layer of epithelium, of which the superficial cells are squamous in the navicular and prostatic regions and columnar elsewhere, on a connective-tissue basement substance particularly rich in elastic fibers to allow for the great distensibility of the canal.

THE ANTERIOR URETHRA

In the anterior urethra the mucous membrane is surrounded, except in the fossa navicularis, by a very thin longitudinal layer of unstriped muscle fibers (in direct continuity with the inner fibers of the prostate), and these are in turn surrounded by a circular layer of unstriped muscle. These circular fibers are so few around the spongy urethra that their very existence was denied by Sappey. Finally, the anterior urethra is surrounded from triangular ligament to meatus by the corpus spongiosum, except for the half inch nearest the bladder, where the corpus spongiosum fails to cover the roof of the urethra and is enlarged below into the *bulb*.

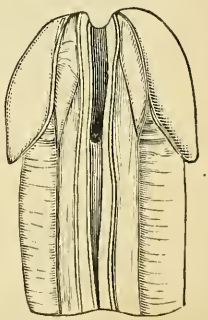


FIG. 15.—LACUNA MAGNA. (Cruveilhier.)

Crypts and Glands.—In the roof of the fossa navicularis lies the *lacuna magna* (Fig. 15), a simple pocket in the mucous membrane with its orifice toward the meatus, and consequently open to entrap small instruments. This lacuna varies greatly in size in different persons, being sometimes entirely absent, and occasionally running as far back as the triangular ligament, forming the so-called double urethra (*q. v.*). A few other smaller lacunae lie along the roof of the penile urethra. *The glands of the urethra,*[1] to be distinguished from the lacunae, are of the compound racemose type, of very small caliber, lined with a cylindrical epithelium. They lie chiefly on the roof of the anterior urethra, and are more numerous in its deeper parts. They are also found on the roof of the membranous urethra. In some instances they pierce the sheath of the corpus spongiosum and extend for some

[1] Paschkis, *Monatsbericht f. Urol.*, 1903, No. 6; and Lichtenberg, *Beitr. z. Histol., etc., d. Urogenital Kanals, etc.*, Wiesbaden, 1906.

distance within it—an important fact in relation to organic stricture of the canal, since these glands convey the products of urethral inflammation into the corpus spongiosum and so involve it in the subsequent cicatrization. *Cowper's glands* are two small, round, lobular bodies, each about the size of a cherry stone, lying just behind the bulb of the urethra in the muscle between the layers of the triangular ligament. Their ducts open on the floor of the bulbous urethra.

The color of the membrane is pale pink. In rest its walls are in contact, obliterating the cavity of the canal, so that a cross-section presents a transverse slit instead of an opening (Fig. 18).

The anterior urethra is called the *external urinary tract,* and the canals and reservoirs beyond the *internal urinary tract,* for the anterior urethra is in free communication with the surface of the body and harbors all the microörganisms that may lie thereon. As a general thing it does this with perfect impunity. Its *flora* include the bacteria found upon the skin; notably pseudodiphtheria bacilli and staphylococcus albus (p. 166). Such bacteria as flourish normally in the anterior urethra, being constantly washed out by the urine, and entering only through the meatus (except under pathological conditions), are most numerous in the fossa navicularis, and indeed are usually found only in that region.

THE POSTERIOR URETHRA

The posterior urethra, extending from the anterior layer of the triangular ligament to the bladder, presents many notable points of contrast with the anterior urethra. The canal is no longer surrounded by erectile tissue, and, indeed, it could scarcely become erect, for whereas the anterior urethra is freely movable with the penis, the posterior urethra possesses a fixed curve—of which later. Moreover, the posterior urethra is, in its normal state, entirely free from the bacteria harbored by the anterior urethra; it is the lowest section of the aseptic internal urinary tract.

The posterior urethra is divided into the membranous and the prostatic urethra, and the trigone of the bladder.

The Membranous Urethra.—Of all parts of the canal the membranous urethra is the most fixed, running, as it does, from the aperture in the anterior layer of the triangular ligament to the aperture in the posterior layer. Its mucous membrane, though of a darker color and much more sensitive, does not differ in structure from that of the anterior urethra. This in turn is surrounded by a thin layer of unstriped muscle, but instead of being sheathed in the corpus spongiosum, it is embedded in the voluntary muscle that fills the space between the two layers of the triangular ligament. This muscle has had special names given to different portions of it by Guthrie, Müller, Wilson, and others, but it

may be considered clinically as one muscle, the *constrictor* or *compressor urethrae,* the *cut-off* muscle, the external or voluntary sphincter of the bladder. The last term best expresses its function. It is the muscle by which the outflow of urine from the bladder is voluntarily opposed. It may suffer from spasm, and so not only prevent urination, but also present a serious obstacle to the introduction of instruments. This is spasmodic stricture (*q. v.*).

The Prostatic Urethra.—The prostatic urethra tunnels the pros-

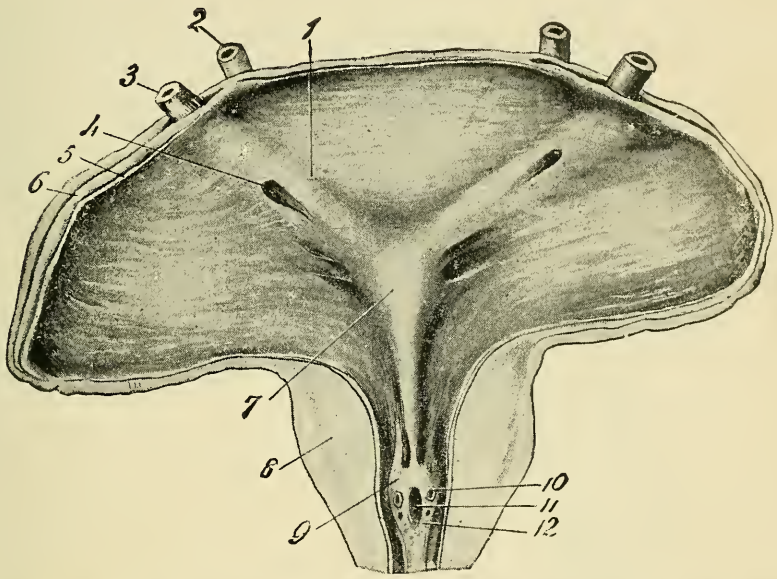


FIG. 16.—LOWER PART OF THE MALE BLADDER, WITH THE BEGINNING OF THE URETHRA. Exposed by incising the anterior wall and laying it open. 3, ureter; 4, opening of the ureter; 2, vas deferens; 9 verumontanum; 7, center of trigone; 8, section of prostate; 10, orifice of the common ejaculatory duct; 11, opening of utricle; 12, mouths of prostatic gland ducts; 1, interureteric fold. (Henle.)

tate, sometimes barely covered by that organ above, sometimes deeply embedded in it (Fig. 18). It is fixed only where it joins the membranous urethra. It is fusiform in shape, being closed internally by the internal or involuntary sphincter of the bladder. Into it the ducts of the sexual organs empty. It is lined by squamous epithelium like that of the bladder, and is liable to great deformity and obstruction by prostatism. Upon its floor rises a little mass of erectile tissue, the *verumontanum,* or caput gallinaginis, the anterior slope of which is hollowed out into a little cavity, the *sinus pocularis* or *utricle* (Fig. 16). The prostatic ducts open upon the floor of the urethra on each side of the verumontanum. The ejaculatory ducts usually open in the sinus pocularis or on its edges.

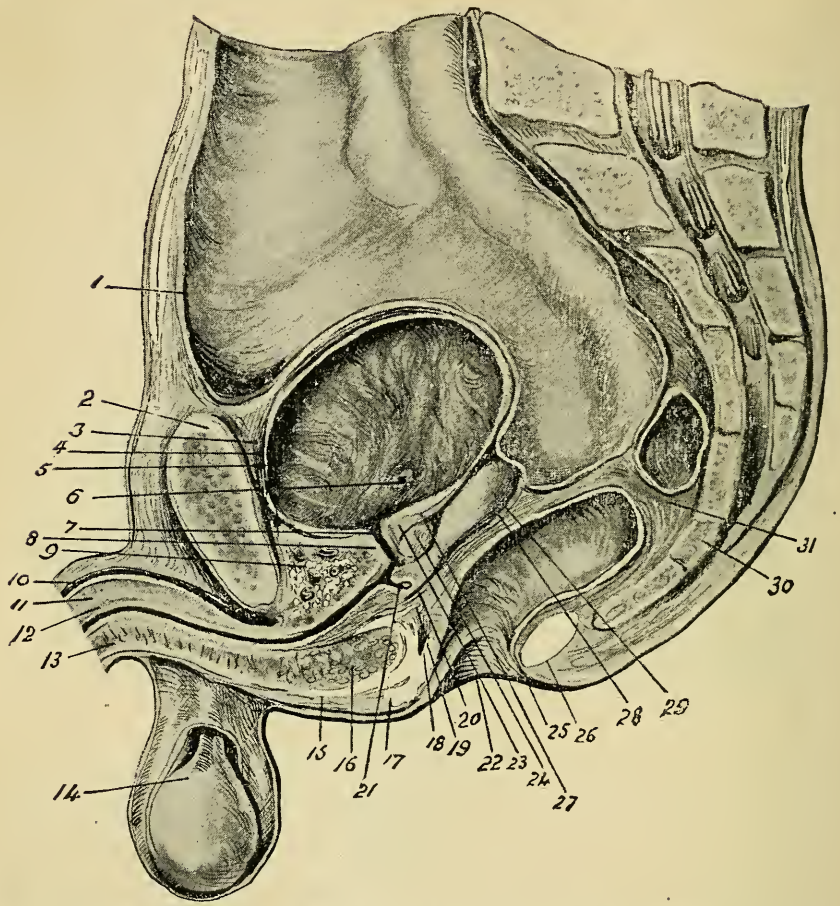


FIG. 17.—SAGITTAL SECTION OF A FROZEN MALE SUBJECT. The small intestine is removed. 1, peritoneum; 6, opening of the ureters; 8, internal sphincter; 9, external sphincter. with the compressor urethrae muscle; 10, dorsal vein of the penis; 15, bulbocavernosus muscle; 16, bulb of the urethra; 17, sphincter ani; 21, utricle; 24, isthmus of prostate; 29, seminal vesicles. (Henle.)

THE SPHINCTERIC MECHANISM

The urinary tract, like the intestinal tract, possesses two sphincters, an internal sphincter of unstriped muscle and an external sphincter of striped muscle fiber (Fig. 17).

The External or Voluntary Sphincter.—This is the constrictor or compressor urethrae, mentioned above. It surrounds the membranous urethra almost to the apex of the prostate. On the upper surface of the urethra the fibers of the compressor continue back for a centimeter or more over the anterior surface of the prostate.

The Internal Sphincter.—The internal sphincter surrounds the neck of the bladder and spreads out fanlike throughout the trigone of

the bladder, reaching the ureteral mouths, and thus forming a connecting band between the ureters and the urethra.

THE VESICAL TRIGONE

Kalisher[1] has plainly shown that the trigone, i. e., the triangular portion of the bladder floor lying between the orifices of the urethra and of the ureters, belongs to the urethra and not to the bladder. The trigone develops with the urethra and the ureters, while the bladder is developed from the allantois. The muscle of the trigone is the internal sphincter. The mucous membrane contains papillae and a few scattered glands (which the bladder proper does not). The circulation of the lower ends of the ureters, the trigone, and the prostatic urethra is derived from the inferior vesical artery. The lymphatics of the trigone are more numerous than they are elsewhere in the bladder, and are in direct communication with those of the posterior urethra.

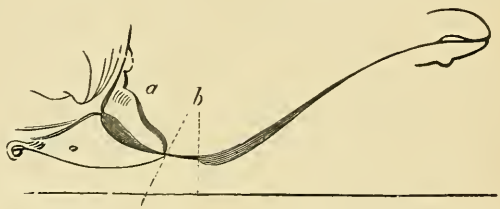


Fig. 18.—Longitudinal Section of Urethra. *a*, *b*, and *c* represent the prostatic, membranous, and spongy portions of the urethra. (Thompson.)

Length.—The length of the urethra, varying as it does in different individuals and in the same individual with erection of the penis and hypertrophy of the prostate, may be set down as averaging 20.5 cm. ($8\frac{1}{4}$ inches),[2] and varying in different normal individuals from 18 to 23 cm. ($7\frac{1}{4}$ to $8\frac{3}{4}$ inches). The posterior urethra is usually 5.5 cm. ($2\frac{1}{4}$ inches) long—2.5 cm. (1 inch) to the membranous portion, 3 cm. ($1\frac{1}{4}$ inches) to the prostatic—and the anterior urethra 15 cm. (6 inches) long, subdivided as follows: 2.5 cm. (1 inch) to the navicular region, 6.25 cm. ($2\frac{1}{2}$ inches) to the penile, 3 cm. ($1\frac{1}{4}$ inches) to the scrotal, and 3 cm. ($1\frac{1}{4}$ inches) to the bulboperineal.

Diameter.—The diameter of the normal urethra (Fig. 18) varies even more than the length—it has been estimated at from 2 to 6 lines. A fair average is not larger than 0.75 cm. (0.3 inch); about No. 27, French scale. But, whatever its size, the urethra is not a tube of uniform caliber from end to end. It has naturally four points of physiological narrowing: the first at the meatus, the second at the penonavicular junction, the third beginning about half an inch back of this, and becoming most pronounced at about the penoscrotal junction. The fourth and fifth constrictions are the voluntary sphincter (the entire membranous urethra) and the internal involuntary sphincter (the neck

[1] "Die Musculatur des Dammes," p. 151.

[2] Keyes, *Am. J. Med. Sci.*, 1898, cxvi, 125.

of the bladder). Of these five narrow points, three, it will be observed, are organic and situated in the anterior urethra, while the other two are muscular and situated in the posterior urethra. The muscular constrictions are widely dilatable, and the caliber of the canal is determined by the meatus, normally the narrowest point. Hence the caliber of the urethra is the caliber of its normal meatus. The penonavicular and penoscrotal constrictions are usually mere irregularities in the canal, besides which there are often lesser contractions at various points, making the urethra, when distended, not a smooth, evenly calibrated tube, but a very irregular one. The three chief *dilatations* of the normal canal are the fossa navicularis, which is situated just inside the meatus; the bulbous urethra, occupying a position immediately in front of the triangular ligament, and the prostatic urethra (Fig. 18). Of these the second is the largest.

Curve.—In relation to these variations of caliber Guyon's observations upon the relative qualities of the urethral roof and floor are of interest far more from a practical than from a theoretical point of view.[1] His observations may be classified as follows:

1. The roof of the urethra (when the penis is erect) forms an uninterrupted curve from the fossa navicularis to the bladder.

2. All the variations of caliber, except the fossa navicularis, are produced at the expense of the floor, which is, in consequence, very irregular.[2]

3. The mucous membrane of the roof is more closely adherent to the subjacent structures than that of the floor.

4. The mucous membrane of the floor of the urethra is much more elastic than that of the roof.

Therefore, not only is the floor of the urethra more irregular than the roof, but its irregularities may be increased with much greater facility by any object introduced into the canal, as well as by disease. In other words, instruments, especially if small and rigid, may, with their points, furrow the floor of the urethra until, finally, they become pocketed (usually in the bulb), and so are brought to a full stop, while an instrument whose point impinges always on the roof avoids these obstructions and glides easily into the bladder. Therefore this eminent French surgeon has termed the roof the surgical wall of the urethra—the wall, namely, which is the guide to instruments entering the bladder. That fistulae and false passages almost always occur in the floor and lateral walls, and that the orifice of a stricture is usually nearer the roof than the floor—these two facts make the roof the surgical wall in disease even more than in health.

[1] "Leçons," ii, 309 *et seq.*

[2] Though not absolutely accurate, both of these observations are clinically correct.

THE CURVE OF URETHRAL INSTRUMENTS

From these considerations it follows that *the curve of the urethra is the curve of its roof.* Now the entire anterior urethra is freely movable with the penis, and can be made to assume any curve. Not so the posterior canal. The membranous urethra, bound tightly at its extremities by the two layers of the triangular ligament, is the real fixed point of the urethra, and runs at a distance of from 1 to 2 cm. ($\frac{2}{5}$ to $\frac{4}{5}$ inch) below the symphysis pubis. In front of this the bulbous urethra tends slightly upward because of the tension of the suspensory ligament and of the skin and fascia, while a similar elevation is given to the prostatic urethra behind by the puboprostatic ligaments and the anterior fibers of the levator ani muscles. Thus is formed the so-called fixed curve of the urethra—not a true fixed curve, for by depression of the bulbous and the prostatic urethrae to the level of the membranous portion it can be, and often is, transformed into a straight line—as when a sound is pushed home until its shaft is in line with the patient's body, or when straight metal instruments are introduced. The curve varies [1] slightly in different persons, and in the same person at different periods of life, being shorter and sharper in the child, longer in the old man. An enlarged prostate lengthens the curve.

PHYSIOLOGY OF THE URETHRA

Sensibility.—Under normal conditions the sensibility of the anterior urethra is slight, although it is exquisitely sensitive when inflamed. The prostatic urethra may be excessively sensitive, while the

[1] The proper average curve, as recognized by Sir Charles Bell and insisted on by Sir Henry Thompson and Dr. Van Buren—the one which will mathematically accord with the greatest number of urethrae—is that of a circle 8.125 cm. in diameter; and the proper length of arc of such a circle, to represent the subpubic curve, is that subtended by a chord of 6.875 cm. long. An instrument made with a short curve of this sort will readily find its way through the normal urethra into the bladder without the employment of any force. It is very desirable that instruments intended for habitual use should be so constructed, inasmuch as many of the difficulties of catheterism are due to a defective curve in the instrument employed. The defect most frequently encountered is too great straightness of the last half inch—a deviation of the curve at its most important point. In an instrument properly made it will be found that a tangent to the axis of the curve *at its extremity* will intersect the projected axis of the shaft at a little less than a right angle. If the curve comprised only a quarter of the circle, the tangent would meet the projected shaft at a right angle; but instruments made a little longer, as they are usually found, invariably have the *last part of the curve* tilted off into a faulty direction, making the angle between a tangent to the axis of the curve at this point and the projected axis of the shaft obtuse, and falling within the right angle.

membranous portion of the canal is always somewhat sensitive. Indeed, the first passage of an instrument through this part of the urethra of a nervous individual is attended not only by pain, but also by a decided shock. He becomes pale and nauseated, may even faint, if not already in a recumbent position; while the recorded deaths ensuing upon this simple maneuver, though few, attest its severity.[1] This acute sensibility becomes rapidly deadened, unless the canal is inflamed, so that after a few repetitions the operation is attended by no shock and but little, if any, pain.

This *urethral shock* is an element in some cases of so-called urinary fever. It is rarely the sole cause of death, but often contributory by its reflex action upon diseased kidneys, and tingeing the frankly septic cases with a neurotic element not otherwise to be explained. Moreover, it contributes to the elucidation of the mystery of urethral neuralgia and urethral spasm, and is doubtless concerned in the explanation of the fact that the form of septicemia known as urinary fever, so common after injury to the deeper portions of the canal, becomes less and less to be feared the farther forward the injury, and is unheard of when the trauma affects only the balanitic portion of the canal.

Mobility.—The *muscles* of the penis and urethra are thrown into action only during urination or erection and emission, and their functions are therefore more fitly described under these titles. A few words concerning *the cut-off muscle* may not be amiss in this place. Besides its most important function of preventing the urine from escaping from the bladder by an effort of the will and of cutting off the stream, it presents several interesting physiological characteristics. The urethra in front of the cut-off muscle swarms with bacteria, while all beyond is germ-free. This is so, not because the muscle presents an impassable barrier, for it does not. When violently contracted it doubtless does form an insurmountable barrier to bacterial invasion, but its periods of contraction, like those of the external sphincter ani—to which it bears a close resemblance—are comparatively infrequent and of short duration. Its normal tone, however, is sufficient to make the channel a narrow and difficult one, readily cleansed of any chance invader by the periodical outflow of urine. It is suggestive, moreover, that the cut-off muscle surrounds the most sensitive part of the urethra. Hence the cause of spasm in this muscle, whether acute from some local or general shock, or chronic as a specific evidence of a neurotic habit, is not far to seek.

[1] They are doubtless due to *status lymphaticus.*

TECHNIC OF THE PASSAGE OF SOFT URETHRAL INSTRUMENTS

Antiseptic Preparations.—The instruments are sterilized, the operator's hands washed and the meatus and glans cleansed, as described in Chapter III.

Lubrication.—The object of lubricating a urethral instrument is *not to make the instrument slippery, but to let it slip through the meatus.* A small dab on each lip of the meatus is all that is needed, and this is best applied, not by greasing the whole shaft of the instrument, but by transferring a bit of lubricant to its tip, and with it smearing the lips of the meatus.

Position of the Patient.—The patient should lie flat upon his back for the first instrumentation, since this sometimes causes marked nervous shock. But for subsequent operations he may assume any convenient position.

Introduction of the Instrument.—The catheter is readily introduced as far as the bulbous urethra. Up to this point the urethra offers no obstruction, unless the meatus is unusually small (p. 251). But unless the penis is held at right angles to the patient's body, the bend of the urethra at the point of attachment of the suspensory ligament (just back of the penoscrotal angle) offers a slight resistance.

At the junction of the bulbous and the membranous portions of the urethra the catheter encounters the compressor urethrae muscle. This muscle may present a scarcely perceptible obstacle or it may be excited to reflex spasm of such intensity as to prevent the entrance of the catheter.

Method of Overcoming Spasm of the Compressor.—When the advance of the catheter is obstructed by the compressor urethrae, the tip of the instrument may lie just within the grasp of the outer fibers of this muscle or it may pass down into the pocket of the bulb.

The first maneuver to overcome this obstacle is to crowd the catheter gently but firmly into the urethra and hold it there for half a minute. On releasing the catheter it either springs back or remains in place. If it springs back it may be taken for granted that the tip of the instrument is pocketed in the bulb, and does not present at the opening of the muscle; it must then be removed and another instrument selected. But if the catheter does not spring back it may again be crowded against the muscle in the hope that a slight advance has been made and that further pushing will finally overcome the spasm.

The second maneuver is to select an instrument that will present its point accurately at the orifice of the muscle and have sufficient rigidity to overcome the spasm. The best instrument for this purpose is the

"natural curve" woven catheter. It usually slips readily into the posterior urethra.

The third maneuver is to aid the passage of the woven catheter by gentle pressure upon the floor of the bulbous urethra with a finger against the perineum, while with the other hand the catheter is gently pushed forward.

The fourth maneuver is to replace the woven instrument by a metal one, and to pass this according to the rules laid down below. If properly performed, this maneuver always succeeds.

Method of Passing the Neck of the Bladder.—When a flexible catheter has passed the compressor muscle of a normal urethra it enters the bladder without further difficulty. But if the catheter stops we know that its point has caught in the floor of the prostatic urethra in front of the internal sphincter. It may be lifted out by pressure with a finger introduced into the rectum.

TECHNIC OF THE PASSAGE OF METAL INSTRUMENTS

The penis, properly cleansed (p. 27) and with foreskin drawn, is held at right angles to the patient's body while the lips of the meatus are lubricated by a touch with the tip of the instrument.

The shaft of the instrument is held over the fold of the groin, its handle nearly in contact with the skin, from which latter (the integu-

Fig. 19.—Introduction of Sound.

ment, first of the groin and then of the abdomen) it is not to be removed until the point of the instrument is about to enter the membranous portion of the urethra. The instrument, at first held along the groin, with point high and handle low (Fig. 19), is introduced at the meatus, and the penis molded up over it. It is not pushed into the urethra, but the urethra is made to swallow the instrument, as it were.

When the curve, and perhaps an inch of the shaft, have disappeared within the meatus, the handle of the instrument is swept around over the surface of the belly, so as to lie exactly over the linea alba, parallel

Fig. 20.—Introduction of Sound.

with it, and still close to the integument. The whole shaft of the instrument is now to be gently pressed toward the patient's feet, being still kept close to and parallel with the surface of the belly (the penis, meanwhile, being lightly grasped behind the corona glandis and held steady).

The point of the instrument may be followed with the little finger of the hand which manages the penis, and, when it gets fairly past the penoscrotal angle, the whole scrotum, with the testicles and penis, should be largely seized with the hand and pressed against the pubis, with slight upward traction (Fig. 20). The point may now be felt to settle down and adapt itself to the subpubic curve, after which the weight of the instrument, properly directed, should carry it into the bladder.

As soon as the curve lies well against the symphysis, the scrotum, testicles, and penis should be dropped; the hand which held them takes

the instrument, steadies it in the median line, and gradually carries the shaft away from the abdomen (Fig. 21), making the handle describe the arc of a circle, and depressing the shaft between the thighs until it lies nearly in the same plane with them. No pushing movement should be imparted to the instrument during this time. The handle is made to describe the arc of a circle, and in a healthy urethra the point cannot go astray. While the instrument is being depressed between the thighs, the free hand is employed in pressing down upon the mons veneris and the root of the penis (Fig. 21), to stretch the suspensory ligament—a point of importance to the easy introduction of an instrument.

Fig. 21.—Introduction of Sound.

The instrument should be withdrawn with the same deliberation and care with which it is introduced. No traction is needed. The motions used in introduction are simply reversed. The handle of the instrument is lightly caught, and without traction made to describe the arc of a circle until it touches the abdomen over the linea alba. It is then carried around to the groin, and, by a tilting motion, unhooked from the urethra, ending exactly where it commenced along the groin, the handle low, the point high.

The first principle of instrumentation in the urethra is to avoid the use of force. Even in a healthy subject the beak of the instrument may become pocketed in the floor of the urethra. It is to avoid this that upward traction on the scrotum and penis is made, whereby the beak of the instrument is held in contact with the roof of the urethra, the surgical

wall, until it gently slides of its own weight into the bulb and impinges against the triangular ligament. Here the beak of the instrument naturally sinks into the sinus of the bulb, and ceases to advance. Now it is that the operator, by pressing downward the mons veneris, tilts the instrument so that its beak touches the roof of the canal, and slides gently into the membranous urethra, the cut-off muscle relaxing before it. But often the beak is not so readily liberated. That it is still caught in the bulb may be known by the bulging out of its curve in the perineum as the shaft is being depressed between the thighs, and by the rebound of the handle when liberated. The obstacle is overcome by gently maneuvering the point of the instrument, by partial withdrawal and reintroduction, or by slight depression of the beak, then lifting it over the obstacle with a finger in the perineum, at the same time pressing down upon the shaft of the instrument to make its point sweep the roof of the canal. The dangerous *tour de maître*[1] should never be tried, nor any force used in the manipulations at this point, as a false passage is easily made here and under these very circumstances. The depression of the handle of the instrument alone is capable of exerting enormous power. The sound represents a lever of the first order, and the surgeon has the long arm.

With a little patience a suitable instrument will always pass into the bladder unless there is a stricture. When the point has traversed the membranous urethra it must continue on freely if the prostate is normal. The so-called spasm of the neck of the bladder does not exist as an obstruction to the passage of instruments.

The sound need only be introduced far enough to bring its greatest diameter into the membranous urethra. This is accomplished when the shaft has been depressed almost, but not quite, to the plane of the body. To pass it farther, so as to straighten out the prostatic urethra, is unnecessary, painful, and, in certain cases, dangerous.

Instruments small enough to engage in the sinuses of Morgagni are not used in the healthy canal. Instrumentation in morbid conditions will be detailed in connection with the different diseases requiring it.

The *cystoscope* and the *stone searcher* are introduced in the manner above described; but the depression of the handle is carried far enough to permit the angle of the instrument to slip over the bladder neck, an occurrence signalized by a distinct jerk on the part of the instrument.

The sensation experienced by a healthy urethra is that of hot points pricking the canal along the part being traversed by the instrument. As this enters the membranous urethra, a desire to urinate begins to be

[1] The *tour de maître* consists in introducing a sound with the shaft between the patient's legs until the point is arrested at the bulb; then the handle is rapidly made to describe a semicircle until it reaches a vertical position, when it is at once depressed between the thighs. This is brilliant but dangerous.

felt, which increases as the prostate and the neck of the bladder become distended by the instrument, so that the patient sometimes believes the urine is flowing away, in spite of the surgeon's assertions and his own observation to the contrary. Nausea, and even syncope, may occur as the instrument distends the prostate, especially on the first introduction in sensitive young people. Occasionally distention of the prostatic sinus produces a partial erection.

If the patient faints, the instrument should be withdrawn at once and the legs elevated, while the head is hung over the edge of the lounge upon which he lies. The facility with which this may be done, if necessary, is one of the reasons for placing the patient on his back for his first catheterization.

The more serious *complications* of catheterization, such as false passages, urethral fever, etc., will be considered in the succeeding chapters. Ordinarily speaking, none of these complications need be expected to follow the gentle passage of a clean instrument into a urethra which is neither inflamed nor lacerated; but in order to avert the possibility of cystitis or chill it is safe to *terminate every catheterization or sounding by an instillation along the whole urethra of a few drops of silver-nitrate solution* (1 : 1,000), unless some other solution is used as a part of the treatment, or the temper of the urethra is well known.

CHAPTER V

CYSTOSCOPY

Cystoscopy is inspection of the interior of the bladder. The instrument employed, the cystoscope, consists essentially of a tube or telescope, through which the operator looks, and a source of illumination. Modern cystoscopes are of two types, viz.:

1. The closed tube cystoscope, employed with water in the bladder (Leiter, Nitze, Albarran, Brunner, Boisseau du Rocher, etc.).

2. The open tube cystoscope, employed with air in the bladder (Kelly, Luys).

The Closed Tube.—This instrument, originally devised by Leiter and Nitze, modified and improved by many urologists and instrument makers, is almost universally employed at the present time. It is fully described below.

The Open Tube.—For use in women Howard Kelly devised a straight open tube cystoscope, to be introduced with the patient in the knee-chest position and illumined by light reflected from a head mirror.

Luys has adapted this instrument for use in the male, by introducing it on a flexible obturator, and adding a suction tube to keep the bladder dry, so that the knee-chest position is not required.

Although the inventors of these instruments employ them with great skill their range of vision is much more limited than that of cystoscopes of the closed tube type, and I have never employed them.

THE CYSTOSCOPE

In its present form it consists of two parts, the sheath and the telescope.

The Sheath.—The cystoscope sheath (Fig. 22) is a metal tube that serves three purposes:

1. It conveys an electric light into the bladder.

2. It permits irrigation of the bladder before, during and after the cystoscopy.

3. It admits a telescope through which the interior of the bladder is observed.

The Telescope.—The cystoscopic telescope permits the observer to

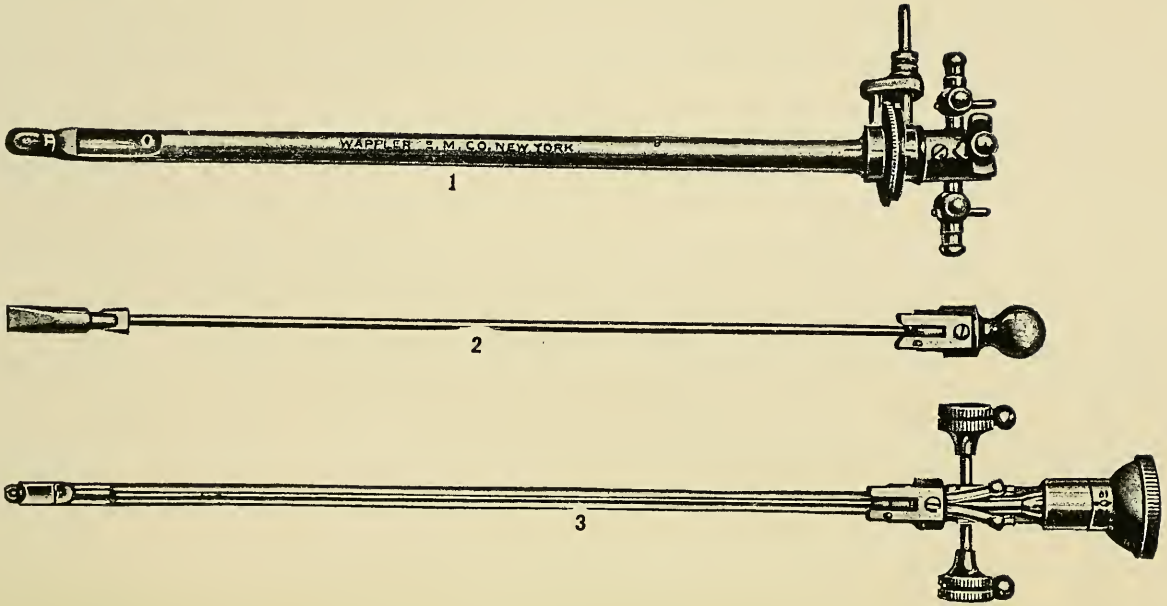


FIG. 22.—THE BROWN-BUERGER CYSTOSCOPE. 1, sheath; 2, obturator; 3, telescope.

inspect the interior of the bladder, to insert catheters or bougies into the ureters, and to manipulate wires, snares, pincers, etc., for the purpose of performing certain operations within the bladder.

The lenses of the telescope may be arranged in three ways, viz.:

1. The prismatic, or indirect-vision telescope (Fig. 23) looks out at right angles to the shaft of the sheath. The window through which it looks may be on the concavity (Nitze type) or the convexity of the sheath. The Nitze type enjoys a more general popularity, but admirable instruments are made in both types. Each has its advantages. The prism naturally inverts the image (Fig. 24) but a system of lenses has been devised to correct this inversion without sacrificing light.

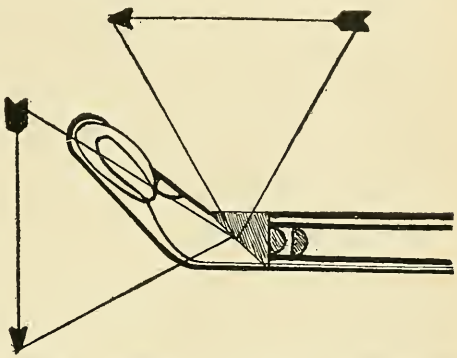


Fig. 23.—Lenses of Prismatic Cystoscope. (After Young.)

2. The direct-vision telescope (Fig. 24) looks directly out through the end of the sheath. It has the same restricted field of vision as the open tube instruments. This type of telescope, though never generally employed abroad, still enjoys considerable popularity in this country. But recent improvements in the prismatic telescope make it the better implement from every standpoint.

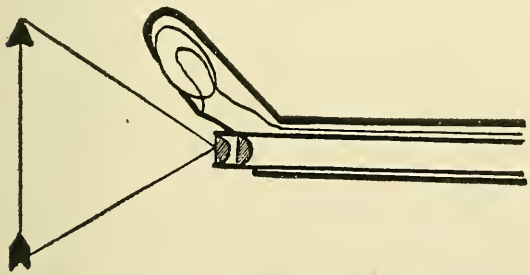


Fig. 24.—Lenses of Direct Vision Cystoscope. (After Young.)

3. The retrograde telescope looks back toward the observer. Such an instrument is calculated to give an exceptionally good view of the bladder neck and adjacent bladder wall. But though Schlagintweit appears to have solved the problem of retrograde vision in his cystoscope, here again the prismatic instrument leaves little to be desired. For through it, by the employment of different degrees of distention, all parts of the bladder may be viewed.

The cystoscope is spoken of as *catheterizing, operating,* or *examining,* to accord with the presence or absence of tunnels, attached to the telescope for the admission of ureter catheters or other instruments. The lever devised by Albarran for the manipulation of these implements

forms an essential part of the telescope to a catheterizing or operating cystoscope. Special telescopes are made for cystoscopic photography.

The Choice of an Instrument.—The following considerations may help in the choice of an instrument:

1. Its maker should be accessible. The importation of cystoscopes from distant countries involves harassing delay, expense and misunderstanding, when repairs are required.

2. The instrument should be simple, its sheath round, its lamp "cold," and preferably with tungsten filament, its lenses corrected for inversion of image, its caliber not more than 24 F. It should admit two 7 F. ureter catheters.

A similar instrument for use in children, of 18 F. caliber, admits one 5 F. catheter.

Beyond this it is impossible to specify. Each year brings forth some new improvement or some change in fashion.

Substitutes for the Cystoscope.—While the cystoscope was approaching its present state of perfection several instruments, entitled "urine separators" were devised by Harris, Cathelin and Luys, as substitutes for the ureter catheterism. But perfection of the cystoscope has eliminated them from the field.

PREPARATION FOR CYSTOSCOPY

INSTRUMENTS REQUIRED

Cystoscopes.—As already described.

Ureter Catheters.—The best sizes are 5, 6 and 7 F. The catheter should have at least two eyes. The Albarran flute-tip catheter (Fig. 25) catches the urine better than any other, but it is well to have a few olivary-tip catheters for entering rebellious ureters. In order to estimate how far the catheter enters the ureter, as well as for the purpose of distinguishing right from the left, it is wise to use an unmarked catheter for one ureter and for the other an instrument marked off in centimeters (Fig. 25).

FIG. 25.—FLUTE-TIPPED CATHETER. Eyes at A, B, C.

Cystoscopic Accessories.—Always have everything in duplicate: cystoscope, lamps, connecting cords, etc.

Source of Light.—If no electric current is accessible one must use dry cells or a storage battery. Ordinarily it is more convenient to depend upon a rheostat attached to an electric light fixture. But when this is in use one must never forget the danger of "grounding" by wet floors and pipes.

When employing the high frequency current for intravesical operations it is safer to derive the cystoscopic current from a storage battery.

Source of Irrigation.—At home one uses a wall tank full of cold sterile water (neither heat nor chemicals being required); elsewhere a Janet piston syringe.

For Anesthesia and Lubrication.—For more than five years I have combined anesthesia, antisepsis and lubrication by the injection into the urethra of the lubricant described on p. 29, to which is added 5 per cent alypin or 2 per cent cocain. The latter is the better anesthetic, and so little of it is absorbed that it is quite free from the very real danger attached to the use of cocain solutions in the urethra.

This lubricant may be introduced through a catheter as it is gradually withdrawn, by means of a small glass syringe.

Other cystoscopists employ 10 per cent novocain solution, 5 per cent alypin solution, or alypin tablets introduced by a special instrument. Cocain solutions should never be used because of the recognized danger of fatal poisoning therefrom.

Urethral Instruments.—One may require a blunt-end bistoury to cut the meatus, bougies or sounds to dilate a stricture, "natural curve" woven catheters, 10 F. (to place in the bladder with the ureter catheter), or 16 F. (to empty the bladder after the cystoscopy).

Other Accessories.—"Visible" ureter catheters for radiography, solutions and syringes for the injection of phenolsulphonephthalein, collargol, morphin, etc., sterile test tubes or bottles, appropriately labeled, for the collection of specimens of urine, basins, rubber apron, urine glasses, etc., should be provided, according to the requirements of the individual.

Sterilizing Accessories.—Green soap, bichlorid solution, sterile wipes, sheets, towels, leglets, gown, gloves, and cap.

STERILIZATION

Instruments.—Most of the instruments and accessories used in cystoscopy may be sterilized by boiling or in the autoclave. Barney has even made the very ingenious suggestion that the ureter catheters be boiled in lengths of rubber tubing and be attached to the cystoscope encased in these, and so fed into the cystoscope, protected from contact even with the operator's hand, not to mention his head.

But the cystoscope itself may not be boiled. It must be sterilized (after due cleansing with soap and then alcohol) in a solution of carbolic acid, alcohol or cyanate of mercury or in formalin vapor.

Such being the case, and inasmuch as the patient's urethra cannot be rendered fully aseptic, I prefer to deal in antiseptics. Accordingly my cystoscopes with their accessory cords, rheostats, etc., are kept sterile

in a cabinet in which a formalin lamp is lighted for at least half an hour before each cystoscopy.

Ureter catheters are cleansed inside and out in running water immediately after use. Then they lie several hours in 1 : 5,000 bichlorid solution. Then they are sterilized inside and out in a small formalin sterilizer. Then they are kept in the formalin cabinet with the cystoscopes. This may seem an excessive sterilization; and, indeed, it prohibits cultivation of bacteria, unless the urine is directly implanted from the catheter into the culture medium.[1] But contemplate the dangers of tuberculosis inoculation from unclean catheters!

The Patient and the Operator.—The penis or vulva should be cleansed with soap and water and bichlorid solution and surrounded by a perforated sterile sheet, as though for a surgical operation. The urethra should be well irrigated with boric acid solution unless the antiseptic anesthetic lubricant is employed.

The operator should be sterilized as for a surgical operation.

PREPARATION OF THE PATIENT

Preparation before Examination.—A preliminary course of bladder irrigation, urotropin medication, or toughening the urethra by the passage of sounds, is appropriate in many instances.

The operation may usually be performed in the physician's office or at the clinic. But enfeebled or nervous patients, especially nervous women, will appreciate being examined at home or in a hospital. And for them a preliminary hypodermic injection of morphin is peculiarly appropriate.

Anesthesia.—The alypin or cocain lubricant has been described above. Fortified by an injection of morphin this will control almost any patient. I have employed spinal anesthesia a number of times for cystoscopy; but not in the past year. For a patient who expects to be out of bed the day after his examination is peculiarly likely to develop severe headache from the spinal puncture.

General anesthesia for cystoscopy of a tubercular bladder is likely to produce a more severe reaction than the same anesthesia when repeated for a subsequent nephrectomy.

Position.—Since the bladder may not empty itself spontaneously through the sheath of the cystoscope if the patient lies flat, the head of the table should be raised. The buttocks are brought to the end of the table, the feet or knees supported on rests (the ordinary lithotomy stirrup is most uncomfortable).

The nervous woman much prefers being cystoscoped in the Sims'

[1] But it does not interfere with guinea-pig inoculations for the diagnosis of tuberculosis.

position. If the bladder is fairly normal this does not entail very grave inconvenience to the operator.

Antisepsis.—See above.

THE CYSTOSCOPY

Testing the Instrument.—When all is ready, the operator glances through the telescope to be sure the lenses are not fogged, then attaches the sheath of the cystoscope to the source of electricity to test the lamp. The rheostat is set at the correct point, the wires again disconnected.

Introduction of the Instrument.—The cystoscopic sheath with its obturator in place is lubricated and introduced.

The female urethra presents no obstruction other than a little tightness sometimes encountered.

The cystoscope is introduced into the male urethra like a sound. Its entry into the posterior urethra is facilitated by firm downward pressure over the pubes to relax the suspensory ligament. It may slip quite readily over the bladder neck or it may have to be still further depressed, aided by the pubic counterpressure until the long axis of the shaft swings beyond that of the patient's body. The tip may even have to be lifted by a finger introduced into the rectum. But one must always remember that, as in the case of the sound, entrance into the bladder is effected by swinging the shaft into correct position, *not by pushing.*

Any doubt as to whether the instrument has actually entered the bladder is settled by removing the obturator, and injecting a little water. This returns freely if the cystoscope is properly placed (with its aperture turned toward the vault of the bladder).

Irrigation.—Enough water is then injected to clear the bladder of blood, pus and lubricant. This is most quickly accomplished by injecting about 50 c.c. at a time. When using a modern irrigating instrument one need not irrigate the bladder beforehand, or take any special precaution to have the fluid absolutely clean before introducing the telescope. For repeated in-and-out irrigation during the operation is the best method of cleaning the field of much pus or blood.

Examination.—The telescope is then introduced, a stop-cock opened to admit the irrigating fluid, and the examination begun as the bladder is filling with water. The patient's complaint, if the bladder is much inflamed, or the obliteration of folds, if it is not, is the signal for shutting off the inflow of water.

The order in which the various parts of the bladder are examined will depend upon the habit of the operator, and will vary somewhat with the emergency of the case. But it is well to follow a definite sys-

tem lest one overlook some unsuspected lesion. The common practice of plunging the cystoscope into the bladder and two catheters into the ureters, and then retreating without so much as a glance about the rest of the organ cannot be too strongly condemned.

We employ the following order in examining the bladder: the bladder neck, the trigone, the ureter orifices, the fundus, especially that part adjacent to the ureters, and finally the vault. With certain cystoscopes one may also examine the posterior urethra as one withdraws the instrument from the bladder.

Ureter Catheterism.—If indicated, the ureters are then catheterized (p. 67), or—

Intravesical Operations.—Any operative work performed.

Close of the Cystoscopy.—At the close of the cystoscopy the bladder is emptied, through the sheath, after withdrawal of the telescope. Then there should be injected about 50 c.c. of 1:5,000 silver nitrate solution, to be urinated out by the patient (if he can empty his bladder) or withdrawn through the cystoscopic sheath (if he cannot).

Treatment after Cystoscopy.—To most patients a cystoscopy means no more than a considerable discomfort for a few minutes, followed by a soreness at the neck of the bladder lasting a day or so. But the operation may be followed by a chill, cystitis, pyelonephritis or renal colic. The infectious complications only occur in cases already infected and draining badly. Hence they may be foreseen and properly guarded against by antisepsis, gentleness, and keeping the patient quiet.

Renal colic following ureter catheterism may not be foreseen. Its usual cause is probably ureteral occlusion by blood clot. Yet it seems much rarer in those who are able to rest after the operation than in those who have to go about. Consequently it is wise to set the cystoscopy for a time when the patient shall have nothing to do for the rest of the day. Inflammatory complications following the operation are to be treated in accordance with the usual rules.

APPEARANCE OF THE NORMAL BLADDER

The Normal Bladder Neck.—As soon as the bladder begins to fill with fluid one may examine the bladder neck. With the prism directed upward, the cystoscope is gently withdrawn until there suddenly appears in the field, close to the instrument, a dark red body. This is the bladder neck. If normal it has a crescentic fold with the concavity away from the cystoscope. This fold may be smooth and regular, and upon it one may see the red outlines of the vessels within the mucosa, or it may be lumpy and edematous looking, showing no visible vessels. Though such a picture suggests inflammation it may well be entirely within the normal, and one should not infer that the bladder

neck is inflamed unless the cystoscope shows evidence of inflammation elsewhere.

Keeping this crescentic fold in the field the cystoscope is now revolved in the direction of the hands of a watch. The normal bladder neck retains its concave, sharply outlined appearance until the cystoscope has made about one-third of a revolution. At "four o'clock," however, the sharply outlined ring flows insensibly into the trigone. The ring is lost in this red surface until the cystoscope has completed another third of its circle. Then at "eight o'clock" it is picked up again and carried around to the starting point. At the junction of bladder neck and trigone one can follow the lateral edge of the trigone as a rather well-defined ridge, by pushing the instrument inward.

The Normal Trigone.—Having completed the inspection of the bladder neck, the cystoscope is once again revolved a half turn to "six o'clock." With the prism looking downward it is now pushed into the bladder about one centimeter and as it goes one observes the surface of the trigone; a surface covered with a sheaf of vessels spread fanwise from the bladder neck toward the posterior edge of the trigone (interureteric bar). That these vessels are not plainly visible may simply mean that the prism is too close to the trigone. Depress the instrument a trifle and they spring into view. After the cystoscope has thus been pushed in about one centimeter from the bladder neck the edge of the trigone, the interureteric bar, springs into view. Up to this point the mucosa of the trigone has been smooth, a rather dark red, and streaked with its radiating vessels. Beyond this transverse bar is seen the fundus, rather wrinkled than smooth, distinctly paler than the trigone, and etched with smaller vessels running hither and thither quite irregularly.

The prominence of the interureteric bar varies greatly in different individuals, and with different degrees of bladder distention. If the bladder is only partly filled, and the patient a man, the bar usually stands out quite distinctly with a definite pocket immediately behind. But if the bladder is distended, and the patient a woman, especially a multiparous woman, the trigonal markings may be quite obliterated; so that one cannot tell precisely where the trigone ends and the fundus begins. Here again the novice is likely to make the mistake of keeping the cystoscopic prism too close to the bladder wall. If he becomes confused let his first thought be to depress the ocular end of the prism in order to get a more distinct view of the interureteric fold. Indeed, if the lens is kept a little way from the trigone the whole of it will be inspected by the motion of pushing the cystoscope in until the interureteric fold comes into view, and then turning it to find the ureters.

The Normal Ureter Mouth.—After the interureteric bar has been identified the ureter mouth is brought into view by simply rotating the

instrument to right or left until the angle of the trigone is seen (Fig. 26). As the cystoscope turns the eye follows the bar until a marked angle or rather peninsula of smooth trigonal surface is seen. This is marked by a few remaining radiating trigonal vessels, is more or less elevated from the surrounding fundus, and extends laterally and upward to be lost in the lateral bladder wall.

As soon as this angle of the trigone is brought into view by rotation of the cystoscope, the rotary motion is exchanged for an angular depression, whereby the ocular end of the instrument is turned away from, and the prism is brought toward, the angle of the trigone. Near the base of the little peninsula, and usually fairly in its middle line, the ureter orifice will be seen.

The description of the ureter orifice is an entirely hopeless task, for no two normal orifices look exactly alike. The color depends largely upon the illumination and distention of the bladder. One may lay down the rule that neither ureter orifice nor bladder neck should be considered inflamed unless there is evidence of inflammation on the adjacent bladder wall.

In shape the normal ureter orifice may appear a wee round hole, a slit, or a "U" fold of mucosa. Contraction of the ureter shows itself by a slight motion in the mucosa followed by a sudden opening of the little hole or slit from which comes a swirl of urine. No very profound conclusions can be drawn from watching the contractions of the ureter. It may be important to note that a bloody or purulent flood issues from it, and one may note that it does contract. But that it does not contract proves nothing. This may be due to reflex inhibition of peristalsis.

Another Way of Finding the Ureter.—Inasmuch as the ureter mouth lies at the junction of the base and lateral edge of the trigone, it may be found by following either of these lines. The method just described is the most generally satisfactory; but in some instances obliteration of the trigonal markings may make the lateral edge of the trigone a better guide. This extends from the bladder neck (at about "four" or "eight o'clock") almost directly inward to the angle of the trigone, and usually can be quite readily followed, if the prism of the cystoscope is depressed fairly close to the trigone, and rotated toward the side so as to throw the lateral edge into sharp relief against the bladder wall behind it.

The Normal Fundus.—The fundus is that part of the bladder lying immediately about and beyond the trigone. Its surface is somewhat irregular, even when the bladder is full, and when the organ is not fully distended the fundus may be thrown wrinkled in folds of considerable depth. For a proper examination of this surface it should be fairly well upon the stretch. Then it appears as a relatively pale mucous membrane, covered with interlacing small red blood vessels.

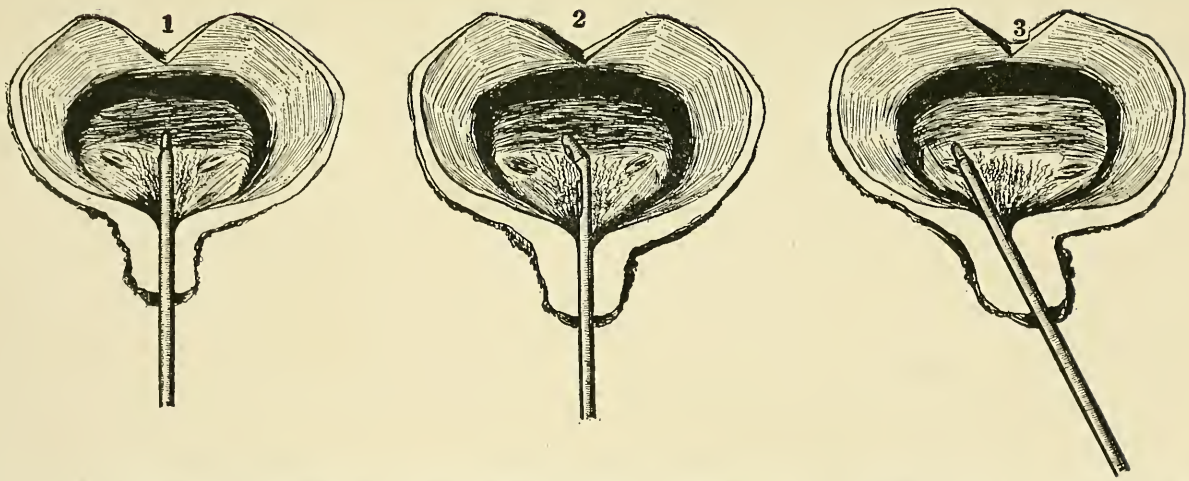


FIG. 26.—MANEUVERS IN CATHETERIZING RIGHT URETER (PRISMATIC CYSTOSCOPE). 1, Cystoscope turned to "six o'clock" to fine interureteral ridge. 2, Cystoscope rotated, following ridge. 3, Beak of cystoscope moved toward ureter.

The region about the angles of the trigone should be most carefully examined as this is the point of origin of most primary papillary tumors and saccules; while here also may be seen the most intense evidence of tubercular and other inflammations.

To examine the fundus fully the ocular end of the cystoscope should be depressed, and the instrument pushed until it will go no further, or until the light becomes obscured by a fold of bladder wall. The instrument is then withdrawn again toward the trigone and, both going and coming, it is rotated gently from side to side, so that the eye sweeps across the whole base of the bladder.

The Normal Vault.—The cystoscope is then turned over until its prism points directly upward. In the rather dim distance one sees the pearly bubble of air that floats at the top of the water in the bladder, and forms the center from which our observations radiate. From this center one withdraws the instrument, moving it a little from side to side, and inspecting the bladder wall until the bladder neck comes into view; then back to the bubble, and a lateral wall is inspected, as the instrument is slowly swept downward until the trigone comes into view. The opposite wall is then covered in the same way, and finally the ocular end of the instrument is elevated and the instrument pushed inward until one has seen all that remains of the bladder wall beyond the bubble. The appearance of the wall of the normal bladder is the same at the vault as at the fundus.

CHAPTER VI

CYSTOSCOPY OF THE DISEASED BLADDER

Indications for Cystoscopy.—Cystoscopy is required for the precise diagnosis of every disease of the bladder and ureters, and every surgical disease of the kidneys. To enumerate these would be to waste space. Even the expert may profitably hold strictly to the letter of this rule. The very case in which it seems most reasonable to omit cystoscopy may conceal some important and unsuspected element that could have been revealed only by this method of examination.

Contra-indications of Cystoscopy.—The most absolute contra-indication to cystoscopy is ignorance or incompetence on the part of the operator. Interpretations of pathological conditions must be founded upon a long and careful study of normal conditions. In the patient, himself, urethral obstruction by stricture, prostate or calculus may prohibit cystoscopy. Gonorrhea is a contra-indication unless the need of information is imperative and the importance of the information to be gained outweighs the danger from urethral trauma. Other contra-indications, such as the irritable bladder itself or the patient's debility, may usually be met by careful preparation and intelligent selection of anesthesia.

THE INFLAMED BLADDER

That the bladder is not inflamed is judged from the appearance in its mucous membrane of fine branching blood vessels. When these blood vessels cannot be seen (through a clear medium) the bladder is inflamed. The neophyte will mistake variations in color of the mucous membrane for inflammation, though such variations may be due to differences in bladder distention and degree of illumination. This tendency to see inflammation where it does not exist he will evince especially in relation to the urethral and ureteral orifices. Mild, general cystitis shows itself only by the disappearance of branching vessels that should be seen in fundus and vault. The trigone is almost invariably the seat of the most marked inflammation. Here it is difficult to distinguish slight inflammation since this may not absolutely obscure the vessels. A more intense inflammation shows itself characteristically by throwing the naturally smooth surface of the mucosa into little

irregularities resembling a granulating surface. But the suggestion of inflammation upon the trigone should always be certified by the absence of vessels in the adjoining portions of the fundus. Observation of this will prevent many mistaken diagnoses of inflammation about the bladder neck, or about the ureter mouth. The more chronic the inflammation of the bladder the more likely it is to be localized.

The appearance of irregularly distributed areas of redness and obliteration of the bladder vessels is often spoken of as characteristic of tuberculosis. Yet this condition is seen in many non-tuberculous conditions; especially in cases of bladder sacculation, ureteral stone and non-tuberculous pyonephrosis.

Ulcers upon the bladder wall occurring in the course of an acute cystitis appear as little white spots quite comparable to aphthous spots of the mouth. The ulceration of the chronic cystitis is seen as an area set in the midst of red mucosa that looks like granulation tissue. The surface of the ulcer itself is usually covered with a sloughy mucous membrane to which blood clots or phosphatic crystals may be adherent. Sometimes the ulcerated surface is distinctly papillary, and suggestive of neoplasm. Leukoplakia I have seen but twice. It showed a white pearly surface in the midst of an intensely inflamed patch. The changes in the ureter mouth seen in cystitis are often suggestive of the origin of the inflammation. They are described below.

TUBERCULOUS CYSTITIS

The changes described above (with the exception of leukoplakia) may, any or all of them, be seen in the tuberculous bladder. The more intense, ulcerative and localized the inflammation, and the more it centers about one or the other of the ureter orifices, the more likely is it to be tuberculous. It is perilous to describe any type of cystitis as peculiar to tuberculosis. Even the little tubercles in the mucosa may be simulated in cystitis cystica.

THE INFLAMED URETER MOUTH

The acutely inflamed ureter mouth shows a distinct edematous swelling of its lips. The redness spreads over and obliterates the vessels on the adjacent portion of the fundus. As a result of the pouting of the ureteral orifice it looks as though the opening were enlarged, though doubtless the swelling actually diminishes the lumen of the canal.

Chronic inflammation of the ureter mouth includes five changes,

viz.: surface inflammatory changes, change in shape, change in function retraction, and change in the ejected stream (*See* Pl. I).

Surface Inflammatory Changes.—These are similar to the changes of chronic cystitis already described. The ureter orifice may be lost in the inflamed mucosa or it may appear as an intensely inflamed or ulcerated region in the midst of which the ureter mouth is very hard to find unless dilated.

Change in Shape.—Inflammatory infiltration and cicatricial contraction about the chronically inflamed ureter mouth may cause various changes in its shape. As a rule the orifice is dilated while the inflammation is still active. This dilatation may make it appear as a long slit, or as a relatively open round hole. The earlier cystoscopists used to describe a "golf-hole" ureter, a rigid, round, wide orifice. Such an orifice is typical of prolonged chronic ureteritis. But it is not often seen, nor is its absence any evidence of the fact that the ureter is not chronically inflamed. The "golf-hole" is changed to a "tunnel entrance" by retraction of the ureter mouth, as described below.

Change in Function.—Just as the ureter may be chronically and severely inflamed without any notable change in the shape of its orifice, so its function is unimpaired by chronic inflammation unless that inflammation has invaded the muscular coat and impaired its peristaltic action. If this has occurred the ureter remains still and open, while the purulent or bloody urine dribbles from it in a more or less constant stream.

Retraction.—Retraction, like interference with function, means infiltration of all the coats of the ureter of sufficient intensity and duration to impair the elasticity of the duct and so to pull the ureter mouth upward and outward. Such retraction is often associated with considerable inflammation and ulceration about the ureter mouth. But if this has in large measure subsided, the ureter mouth may be left open, "golf-hole," and this "golf-holed" orifice retracted toward the side of the bladder appears like the entrance to a tunnel, with the smooth, pale, scarred, tense trigone appearing as the floor of the tunnel.

Change in the Ejected Stream.—Inasmuch as the inflammation about the ureter mouth usually, though not inevitably, implies infection of the kidney pelvis, one may look for pus in the urine ejected. But even though the kidney be gravely diseased, the amount of pus in the ejected ureteral stream may be so little as to be distinguishable only under the best of circumstances as to light, freedom from pain and freedom from pus within the bladder, which can often not be commanded. Therefore, while meatoscopy, as it is called (i. e., inspection of the ureter mouth) may reveal pus issuing from the ureter, this information is obtained more accurately by ureter catheterism. Any considerable delay for inspection of the stream as it issues from the ureter

is worth while only when some previous effort has shown that it is impossible to introduce the ureter catheter.

PROSTATIC LOBES

The projecting lobes of an enlarged prostate show much more plainly within the bladder than they do by rectal touch. If there is enlargement of the middle lobe this is distinctly seen as a tumor arising from the floor of the urethra; so that when the cystoscope is swept around the ring of the bladder neck, at about the place where this should disappear into the trigone, one sees a fold and then a marked projection, a convex instead of a concave object. This convexity crosses the middle line to where the ring of bladder neck is met beyond.

If there is a single lateral lobe that side of the bladder neck is in the same way transformed from a concavity to a convexity with a sharp angle, or fold of the mucous membrane at each extremity. Two lateral lobes project on each side with a fissure between them above, and below. Two lateral lobes and a middle lobe show a set of three convexities with three deep folds between them (Pl. II). The size of the lobe may be measured by the distance the cystoscope must be introduced to keep the edge of the projecting lobe within the field. Such measurements are not wholly accurate.

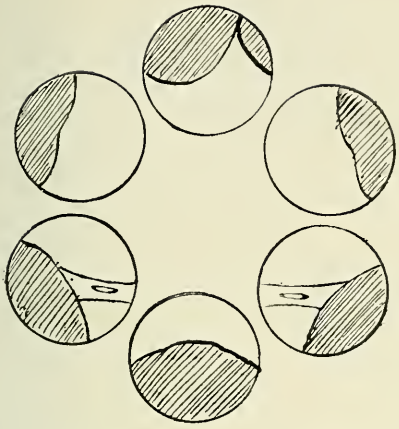
BAR OR CONTRACTURE

A bar or contracture may be utterly invisible. Sometimes, however, one sees a raised bladder neck with the trigone singularly depressed beyond it, somewhat similar to the normal picture of the interureteric fold.

CARCINOMA OF THE PROSTATE

A small carcinoma may, like a bar, produce no change in the cystoscopic picture, while a large carcinoma may so distort the deep urethra as to prevent the introduction of a cystoscope. Sometimes the cystoscope reveals irregular changes in the shape of the bladder neck—usually a series of irregular small nodules. These may be mistaken for inflammation or for an irregular type of prostatism unless they extend into the trigone or vault. Actual infiltration of the mucous membrane, in the form of carcinomatous ulceration or papillary growths, is not so often seen (Pl. I, Fig. 6).

Since the carcinoma is usually primary in the posterior lobe, one usually learns more by rectal touch than by cystoscopy.



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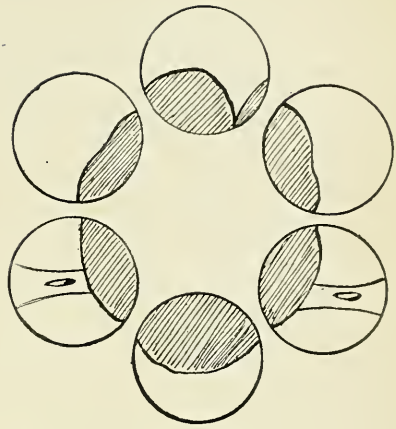

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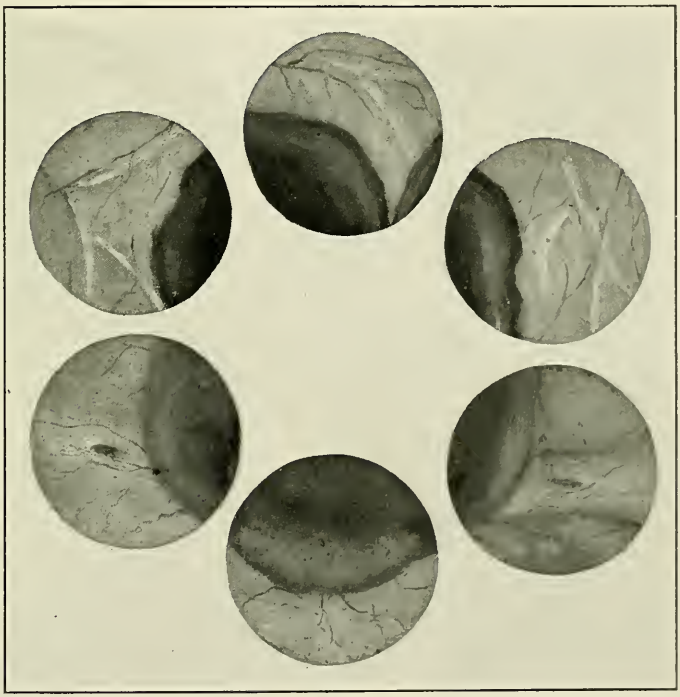


3

CYSTOSCOPIC INTERPRETATION OF THE APPEARANCE OF THE BLADDER NECK IN PROSTATISM.

FIG. 1.—General prostatic hypertrophy, middle and lateral lobes forming one mass—as seen by the cystoscope.

FIG. 2.—Schematic interpretation of Fig. 1.

FIG. 3.—The actual condition

TUMOR OF THE BLADDER

Papillary Tumors.—Cystoscopic inspection does not disclose the malignancy of a papillary growth in the bladder. Inflammatory ulcerations whether encrusted or not may well be papillary. But such papillae are relatively short and are distributed over a relatively large bladder surface. They are obviously not neoplastic. The papillary neoplasm, if small, is seen as a tuft of villi growing from a tenuous pedicle. The large papillary neoplasm is likely to have a cauliflower-like appearance, the villi being packed so close together as to appear fused in bunches. Such a large neoplasm may more than fill the cystoscopic field, and bleed so freely as to obscure the diagnosis. The villi also choke the sheath of the cystoscope and interfere with irrigation. Such tumors are often multiple.

The Ulcerated Papillary Tumor.—Spontaneous ulceration of a papillary tumor usually means that it is malignant. The ulceration covers more or less of the surface of the growth with a white slough, to which phosphatic grit is likely to be found adherent.

The Non-papillary Ulcerated Neoplasm.—Carcinomatous ulceration of the bladder wall cannot be readily distinguished by inspection from inflammatory ulceration. Inflammatory ulcers usually appear about the trigone and bladder neck while malignant ulcers affect the vault and fundus.

Secondary Carcinoma of the Bladder.—Carcinoma invading the bladder from the prostate, the uterus, or other adjacent organs is discovered by other means than cystoscopy but the cystoscope measures the involvement of the bladder wall. The earliest change (excepting growths coming from the prostate) is fixation of the bladder wall at the point of invasion. The fixation may sometimes, though not always, be recognized when the bladder is fully distended by wrinkling or dimpling of the surface drawn to one side. This fixation in cases of tumors extending from the uterus is likely to show itself in the fundus just back of the ureteral orifices. As the carcinoma extends further into the bladder wall the surface of the mucous membrane is thrown into red, edematous folds. The picture shows a circumscribed region not unlike chronic cystitis in appearance. Ulceration does not occur until infiltration has existed for a considerable time. Bullous edema, or vesicles, may appear early (Pl. I, Fig. 5).

Non-infiltrating Neoplasms.—Under this term we include the non-malignant myofibroma of the bladder wall itself, and such tumors of the adjacent tissue (whether malignant or not) as depress the bladder wall without invading it. Such tumors are recognized, after full distention of the bladder, by the fact that they project more or less mark-

edly into the bladder cavity, and difference in distention does not materially alter the position of the point of projection. The mucosa over such projections may or may not be inflamed (Pl. I, Fig. 4).

Cystitis Cystica.—This condition is recognized as a scattered or grouped collection of pearly or pink vesicles distributed over a more or less reddened surface of the bladder.

CHANGES IN THE SHAPE OF THE BLADDER

Apart from the normal variations and inflammatory changes in the shape of the ureteral orifice, and the changes in the shape of the urethral orifice due to prostatism or neoplasm, the following changes are noteworthy:

1. Cystocele.
2. Ureterovesical cysts.
3. Trabeculation and sacculation.

Cystocele.—The importance of cystocele is measured chiefly by the vaginal protrusion, the amount of residual urine and the secondary cystitis. A cystoscopic measure of its extent is the angle at which the cystoscope must be tilted in order to examine the ureter orifice; for in proportion as the anterior vaginal wall gives way, the trigone drops from the long axis of the patient's body to the transverse axis. So that to approach the ureter orifice of the well-filled bladder in a case of cystocele, the ocular end of the cystoscope must be carried well forward under the pubes. Even when this is done the trigonal markings are so much obliterated in these cases that identification of the ureter mouth is often extremely difficult (Pl. I, Fig. 1).

Ureterovesical Cyst.—Small dilatations of the submucous portion of the lower end of the ureter are seen as little pouches that balloon up with each wave of ureter peristalsis. If large they are seen as more or less fully distended cysts. If enormous they may so fill the bladder and distort its landmarks as to be very difficult of diagnosis without collargol injection (Pl. I, Fig. 14).

Trabeculation.—The beginner mistakes the folds in the fundus of the normal bladder for trabeculation; practice in cystoscopy will remedy this error. Slight trabeculation can only be recognized when the bladder is completely filled; it then appears as a crisscrossing of little short elevated ridges in the mucosa (Pl. I, Fig. 3). It is usually most marked in the fundus. Marked trabeculation is unmistakable, and is often associated with sacculation.

Sacculation.—The orifice of a saccule is simply a hole in the bladder wall. The mucous membrane about this may or may not appear inflamed. It may be possible to turn the cystoscope so as to be able to

see the bottom of the saccule. But as a rule its size can only be measured roughly by the introduction of a graduated ureter catheter, and more accurately for the larger saccules, by collargol injection and radiography. An enormous saccule may so distend the bladder as to confuse the cystoscopic picture. In such cases collargol injection is the only resource available.

STONE

Bladder stones so often contain no lime salts that they are overlooked by the x-ray. The cystoscopist readily identifies small stones as white, yellowish or brown, rounded, movable bodies. They are usually seen beside or above the cystoscope, rather than below it. Large stones will be struck by the cystoscope as it is introduced and may simply show an irregular sloughy looking surface which is not always readily distinguished from that of a sloughy neoplasm. The hardness and mobility of the stone generally settles the diagnosis. It is to be remembered that neoplasms may be incrusted with phosphates, and thus give a gritty contact. Stone in a saccule is almost always phosphatic, and therefore discoverable by the x-ray. It may be visible within the orifice of the saccule.

DIFFICULTIES IN CYSTOSCOPY

The dangers of cystoscopy have already been mentioned on page 54. The difficulties of cystoscopy are derived from sources of urethral obstruction, bladder irritability, the presence of pus or blood, and the presence of lesions so extensive as to disfigure the cystoscopic picture.

Urethral Obstructions.—These are to be dealt with as for a passage of a sound or catheter: the meatus cut; stricture dilated or cut; the prostate surmounted by forcible depression of the ocular end of the cystoscope.

The Irritable Bladder.—The bladder may be irritable on account of nervousness of the patient, severe inflammation or actual contraction. Sympathetic management of the individual and thorough anesthesia will overcome these difficulties in large measure. The modern cystoscope permits a fairly complete examination with no more than 50 c.c. of fluid in the bladder, though under such circumstances one may fail to catheterize the ureter.

Pus or Blood.—The presence of much pus or blood in the bladder requires a relatively thorough repeated preliminary irrigation with small quantities of fluid. If the bladder is sensitive and there are no clots in it, this irrigation should be carried out chiefly by means of the

irrigation vents; these admit and expel the fluid much more gently and slowly than when the opening at the end of the sheath is employed. If blood clots are present, however, a few injections through the open sheath with the syringe (alternated with suction if the injected fluid does not return) must precede the more gentle manipulation. Even if the bleeding is free at the time of the examination, a fairly satisfactory exploration may still be made by patiently going over the bladder wall bit by bit while alternating the inflow and outflow through the vents, so that the examination is made practically through clear fluid that is being injected into the bladder before contamination with blood has time to occur. This method of examination is conducted with the bladder almost empty all the time. The use of water at room temperature probably diminishes the bladder and ureteral contraction and this somewhat facilitates the examination.

Pus in the urine itself is not nearly so grave an interference with cystoscopy as blood; for the pus even though it is pure and flows quite freely from the ureter never contaminates the bladder fluid so quickly as free bleeding does. Yet the bladder that contains much pus is likely to be a gravely inflamed bladder and the object of the examination is likely to be catheterization of the ureters whose mouths are lost amid this inflammation. Under such circumstances pyuria may prove an insurmountable difficulty.

CHAPTER VII

URETER CATHETERISM

The day has at last dawned when substitutes for the ureter catheter are not. If the ureter cannot be catheterized we realize the inaccuracy of the separators of Harris, Cathelin and Luys, and the danger of depending upon meatoscopy. Bilateral exploratory nephrotomy gives the only prospect of a diagnosis; and the information afforded by this method of examination is far less accurate than that afforded by the ureter catheter.

THE CATHETER

The best ureter catheters are those of French make. For many years past I have used the instruments made by Eynard.

Size.—The ideal size of a ureter catheter is 6 or 7 French (12 to 14 for the Eynard). The lumen of a catheter smaller than number 5, French, is too small to convey the urinary stream, and even 7, French, is too large to enter many ureters without considerable trauma. Therefore I usually employ a 6.

The Garceau catheter I have never employed; though it might be useful to dilate a stricture.

Markings.—One should make it an absolute rule never to use two identical catheters for an examination. There must always be a distinction between that which is to enter the right ureter and that which is to enter the left. This distinction should be announced aloud before the examination, and should be verified aloud when the catheters are in place and the cystoscope withdrawn. If any dispute then arises as to which catheter is in which ureter the prevailing opinion may be verified in the female by vaginal palpation of the ureter as each catheter is withdrawn; and in the male by injection of enough fluid to cause a slight renal colic. Inasmuch as one is interested to know how far the catheter enters the ureters the most popular type of instrument is painted black on each alternate centimeter and ringed with gold at intervals of five centimeters, so that by watching the catheter enter the ureter one may estimate precisely how far it has gone. It is my custom to use for each examination one plain catheter and one marked off in centimeters, as the equal rings and markings on one will give a precise

estimation of the position of the other and it is impossible to confuse the two.

The Tip.—Every ureter catheter should have at least two eyes on opposite sides. The flute-tipped catheter (Fig. 25) is the best instrument for ordinary use. In case this fails to enter the ureter an olivary-tipped instrument will often succeed.

CATHETERISM OF THE NORMAL URETER

We assume that the instruments have been properly sterilized; the patient's urethra filled with the anesthetic antiseptic lubricant; the cystoscope introduced and the bladder filled and examined.

Finding the Ureter Mouth.—The two methods of finding the ureter mouth, i.e., by the interureteric ridge and by the lateral edge of the trigone, have already been described. The ureter orifice lies usually in the middle of the angle of the trigone at the base of its little peninsula. It is a slit, a round hole or U-shaped. It is flat or slightly elevated; the same color as the surrounding mucosa or a little redder. In order to see it clearly the beak of the cystoscope must be moved to one side until its prism is almost over the orifice and about one centimeter from it. If it is not discovered at first one must wait patiently for half a minute or so, when a little movement will be seen in the angle of the trigone as the ureter mouth opens to eject the urinary stream. If the cystoscope is rightly placed we look for one moment right up into the lumen of the ureter. If after a half minute or so no sign of the ureteral contraction is seen, the ureter catheter should be gently pushed out for about two centimeters and well depressed by turning the lever to a right angle. Following this one proceeds to make pressure upon different points of the angle of the trigone, using the tip of the catheter to probe any suspected region, or laying the whole catheter end against the mucosa, and so depressing it, in the hope of bringing the adjacent ureter mouth into view. The beginner will carry out these manipulations most successfully if he keeps the catheter fixed, and moves catheter and cystoscope as a single instrument. If this also fails, the ureter mouth will have to be discovered by meatoscopy, as described below.

Introduction of the Catheter.—Having found the ureter mouth, the beak of the cystoscope is moved and turned toward it until the lens is less than a centimeter away from it, and a little to its inner side; so that we are looking at approximately "4 o'clock" (for the right ureter). The corresponding ureter catheter is then pushed in until its tip appears, crosses the cystoscopic field and passes just beyond it. Then the lever is elevated enough to bring the tip back into the center of the

field. After this, levers and catheters are kept rigid while, with cystoscope and catheter acting as a solid body, the tip of the instrument is depressed until the tip of the catheter touches the mucosa just proximate to the ureter orifice. Then, again, using catheter and cystoscope as a single solid instrument, it is pushed inward until the tip of the catheter distinctly engages in the orifice of the ureter. With the cystoscope held very steady the catheter is now gently pushed into the ureter orifice. If it has caught in the mucosa it is gently withdrawn, turned a trifle and re-introduced. It is quite likely to be caught at about 1 cm. within the ureter orifice, and again at a depth of 5 cm. it passes the tight point where the ureter issues from the bladder wall.

These are not points of true strictures but of normal irregularities in the ureter. If the flute-tipped catheter will not pass in, it must be exchanged for an olivary-tipped instrument. Beyond 5 cm. the catheter usually goes readily enough, though in the normal ureter it may catch again at 15 cm., where the ureter crosses the pelvis; or between 20 and 25, where it enters the kidney pelvis. One must remember, however, that the mere contact of the ureter catheter always abrades the ureter wall. This abrasion is disclosed by the ureteral epithelia that are always seen in specimens obtained by ureter catheter. Therefore the catheter should be passed up the ureter with utmost gentleness and without the least haste, so that the canal may be given opportunity to mold itself to the rather stiff instrument.

Drawing Urine.—If no impediment has been encountered the catheter is inserted between 25 and 30 cm. Its tip is then in the renal pelvis and it should promptly begin to emit a constant succession of drops. The first ten or fifteen should be discarded, as these represent bladder content that has been carried up the ureter within the lumen of the catheter. After they have flowed away, a sterile test tube is applied to the outer end of the catheter and, while this is collecting urine from the kidney, the ureter catheter is pushed in 1 or 2 cm. to give sufficient slack, and the cystoscope is turned to follow the interureteric bar until it reaches the opposite ureter. The second catheter is pushed in and the second ureter catheterized. With the two catheters thus placed in the kidney pelvis, before removing the cystoscope, the rate of flow is contemplated and if either catheter appears to be delivering urine with abnormal velocity, this is noted; and no further move is made until the flow shall have become more normal. Thus any retained urine in the renal pelvis is emptied out and one estimates the amount of retention. But the mere fact of a rapid flow of urine does not of itself prove retention. It may be due to reflex polyuria in a normal kidney.

If either one of the ureter catheters has not reached the renal pelvis the cystoscope will be kept in place until one is satisfied that this

catheter is functionating regularly. The catheter in the ureter should emit from three to six or eight drops of urine in rapid succession with intervals of from two to ten seconds. If it does not do so it should be withdrawn a trifle, and if this does not help, an injection of one or two c.c. of water may be made into it. The great objection to this maneuver, however, is that it invalidates one of the few absolute, dependable data (urea per cent) obtained by the ureter catheter. If one ureter has not been entered at all the corresponding ureter catheter may be simply introduced into the bladder so as to draw the urine from the uncatheterized side.

Removal of the Cystoscope.—The cystoscope should not be removed until enough urine has been obtained from each ureter (if each ureter has been catheterized) to permit microscopical examination and urea estimation.

1. The first step is to turn the cystoscope with its lens upward and then to push the ureter catheters in so that they coil up in the bladder and leave little more than a centimeter projecting from the catheter channels at the ocular end of the cystoscope.

2. The second step is the removal of the telescope. This is first unlocked (after a glance to be sure that the lever is not elevated) then withdrawn 2 or 3 cm. The protruding tips of the ureter catheters are then pushed sharply inward. This makes the catheter curve up from its bed alongside the telescope. It is thus readily disengaged and the telescope fully withdrawn.

3. The third step consists in emptying the bladder through the sheath. During the withdrawal of the telescope the fluid has been gushing from the bladder. The few remaining drops are quickly emptied out while the ureter catheters are being pushed in still further, until their tips are flush with the outer edge of the sheath.

4. The final step is the withdrawal of the sheath. With its beak turned upward this maneuver is gently performed. If the beak is inclined to hold the ureter catheters and to draw them out this is in some measure prevented by pressure upon the catheters in the bulbous urethra as soon as the tip of the beak has vacated that part of the canal.

Collection of Urine.—As soon as the cystoscope is out the interrupted collection of urine is resumed. The catheters have perhaps been pulled out of the kidney pelvis so that their flow is no longer continuous, drop by drop, but comes in interrupted spurts. Perhaps one of them has been moved to a place where it does not work well. If so, one occupies a minute or two in making the patient comfortable, taking the feet off the stirrups, etc., and waits for the catheter to work. If it remains dry it may be withdrawn tentatively bit by bit until it is no more than 10 or 15 cm. up the ureter (this brings the 25 cm.

mark to the vulva; the 40 cm. mark to the male meatus). If one catheter remains dry in this situation its eyes are probably covered by blood clot, epithelia or purulent shreds, collected during its too hasty introduction. These must be dislodged by a quick injection of two c.c. of sterile water. These injections may have to be repeated. If the injected fluid itself does not return one may as well remove the catheters from the ureters. If approximately all injected fluid returns one may hope that urine will follow. If it does not the catheter is withdrawn into the bladder. Several of these to-and-fro injections may be required to make the catheter work properly. Unless the patient is very sensitive, or greatly alarmed at any further manipulations, it is usually better to employ a number 10 or 12 woven urethral catheter in the bladder rather than the ureter catheter; or the bladder may be emptied by catheter immediately after withdrawal of the remaining ureter catheter.

Whatever the final arrangements, the separate urines are collected in two properly labeled sterile tubes. As soon as the rhythmic flow of urine from each side has been assured an intravenous injection of one c.c. of standard six per cent phenolsulphonephthalein solution is administered. The time of injection is noted and a white enamel dish is moistened with a few drops of sodium hydrate solution (or any other alkali). After two minutes have gone by, a drop of urine from each catheter is permitted to fall into this dish. This is repeated every half minute until the characteristic crimson color is obtained (page 78); then the catheters are transferred to two fresh bottles, and the urine for phenolsulphonephthalein test is collected in these. The duration of this collection may be varied with advantage. For cases with marked disparity in kidney function five minutes may be enough; ten minutes is long enough for the average case; and fifteen minutes for any case. If the urines are to be collected for a longer time than this the oversight is sooner or later delegated to an assistant. This spells disaster. For throughout the examination the constant action of the ureter catheter must be controlled by a no less watchful and intelligent eye than that of the operator himself.

After enough urine has been collected for phenolsulphonephthalein examination one has obtained through the physical and urinary analyses and history, through the data obtained by cystoscopy and those noted in the urines as they flow from the ureter catheters, a general idea of the need for any further specimens to be used for guinea-pig inoculation, or for cultivation of bacteria. These should be collected last, and if the catheters have been sterilized by formalin, specimens for culture should be dropped directly into the culture tube, otherwise the amount of formalin may be enough to inhibit growth. The formalin does not inhibit the growth of the tubercle bacilli.

Further Observations Through the Ureter Catheter.—By this time the patient usually feels that he has had enough. Such manipulations as the measuring of the capacity of the kidney pelvis by injection, or injection for pyelography had better be reserved for a subsequent cystoscopy.

Withdrawal of the Catheters.—The great advantage of the formalin sterilization of catheters is the assurance that they will not transmit infection from the urethra or the bladder into the ureter. If they are gently introduced so as not to produce trauma they can do no serious harm. If using catheters that are merely aseptic, I should prefer to close the examination by the injection of two c.c. of one per cent silver nitrate into each ureter. As the catheters are withdrawn into the bladder an injection of silver nitrate 1 : 5,000 should be made through one of them into the bladder.

Aftertreatment.—If the patient has been badly frightened, or suffered much pain, morphin should be administered by mouth or hypodermic, and he should lie still for at least half an hour before attempting to leave the office. Cases from whom trouble is anticipated should always be examined in a hospital, and in any case the patient should be informed beforehand that he is to cancel all engagements for the rest of the day, and for the next day too; unless a previous cystoscopy has proven that he is not likely to be greatly disturbed by the examination. The patient who is cystoscoped repeatedly usually becomes so insensitive that anesthesia may be dispensed with. Each successive cystoscopy of patients who require numerous examinations proves the importance of the nervous element in their pain.

Variations in Technic.—We have described the method we employ in catheterizing ureters, but the variations in technic of different operators are extreme. In conjunction with or in place of phenolsulphonephthalein and urea estimation, one may employ any renal function test described in the next chapter. One may follow Albarran, and leave the catheters in the ureter from an hour and a half to two hours; or Geraghty, and leave them in half an hour to an hour. Or at the other extreme one may follow Braash who uses a direct vision cystoscope, scorns all renal functional tests and does not even estimate the percentage of urea.

URETER CATHETERISM OF THE DISEASED URETER

Perhaps the most important consideration in catheterizing the diseased ureter is that any accident of catheterization, such as interference with passage of the catheter by obstruction, or interference with the flow of urine by blood clot may occur quite as readily in the normal

as in the diseased. The fact that a ureter catheter is arrested or obstructed does not tell us what the obstruction is.

One should closely observe the flow of urine through the catheter. If this is properly placed in a normal kidney pelvis the urine comes slowly but regularly drop by drop. (If the patient has nervous polyuria it flows rapidly.) When properly placed in the normal ureter the urine comes in an intermittent succession of a number of drops as described above. If improperly placed either in the pelvis or in the ureter the regularity of the flow can be considered only under two conditions:

1. With the catheter in the kidney pelvis there comes first of all a very rapid dribbling of urine, which empties out an accumulation of urine in the pelvis; then the rapidity of the flow diminishes. But thereafter this urine continues to show a relative dilution in comparison to that from the opposite kidney. This is hydronephrosis.

2. With the catheter in the ureter and the bladder empty the flow continues as though it were in the pelvis; this means dilatation of the ureter, and loss of its peristaltic action. Such a diagnosis should be confirmed by pyelography. It indicates dilatation of the ureter down to the point where the eye of the catheter rests, and hydronephrosis above.

Inspection of the urine obtained by ureter catheter is often most misleading. The urine may be clouded by epithelial cells; it may be bloody, though the ureter and kidney are entirely normal. The urine should therefore *always* be examined by microscope.

The collection of urine should usually be delayed until the bladder is emptied; for the chronically diseased ureter may permit reflux of fluid from the bladder, which returns through the catheter in a continuous stream until the bladder is empty.

FINDING THE URETER MOUTH

Inflammation or cicatrization may make the ureter mouth much more prominent than when it is normal; or surrounding inflammation or ulceration may quite conceal it, or retract it to an unsuspected position. Under these circumstances successful catheterization of the ureter requires the instinct born of experience, for it depends upon the rapidity of the finding of the orifice, or upon catheterization without actually seeing the orifice until the catheter enters it. The beginner who has to find the ureter by laboriously tracing landmarks that are all but obliterated, cannot succeed as does the expert who immediately places his cystoscope in approximately the correct position, recognizes the place where the ureter should be found, and is able to enter

the ureter by projecting his catheter in what he considers the right direction, even though the orifice is quite invisible.

Intravenous injection of indigocarmin (p. 78) is an invaluable aid in finding the ureter mouth in difficult cases.

CHAPTER VIII

ESTIMATION OF THE RENAL FUNCTION

Estimation of the renal function forms an important element in the diagnosis of almost every disease of the urinary organs. Yet no method of estimating this function can claim to be wholly accurate or all embracing. Hence, perhaps, the accumulated confusion resulting on the one hand from over-enthusiastic praise of some one method, and on the other from undue pessimism in regard to all. Any attempt at exhaustive evaluation of all the methods advocated at home and abroad would but add to this confusion. We shall rest satisfied with a description of the methods employed by the majority of American urologists today.

To this end we make two postulates:

1. In the first place, the following description refers exclusively to surgical diseases of the kidney. Non-bacterial chronic nephritis does, it is true, frequently complicate the clinical picture of surgical renal disease (infection, retention, tumor); but the tests that most accurately measure the renal function in the latter class of cases are singularly inaccurate in "medical" cases. Furthermore, the test of renal function in Bright's disease is at once so complicated in its technic and so indefinite in its conclusions that we feel doubly justified in neglecting it.[1]

2. In the second place, in the interests of brevity and lucidity we must take for granted a comprehension of renal physiology and also omit a description of many of the methods of estimating renal function. Among these methods many have so definite a value that a brief excuse for this omission is called for.

Thus "Ambard's constant," so much lauded by the French, is not used in the United States. It lacks supreme accuracy; it requires a relatively complex series of observations.

Estimation of the freezing point, whether of blood or urine, has similar defects. (The freezing point of any solution, be it noted, measures the number of its molecules, while the specific gravity measures their weight.)

The nitrogen estimation when applied to urine gives no greater

[1] Cf. Christian, Frothingham, O'Hare and Woods, *Am. Jour. Med. Sci.*, Nov., 1915.

accuracy than urea estimation. When applied to blood it is doubtless more accurate than the freezing point; but its superiority is not fully proven. It should be used to control other tests.

Experimental polyuria and oliguria are but practical applications of the lack of adaptability so characteristic of the diseased kidney, and upon which we shall have occasion to insist. Indeed a study of this phenomenon forms a part of many of our observations. But nothing is to be gained by formal observance of the details either of experimental polyuria or of experimental oliguria.

Phlorizin, methylene blue, and many other substances employed for "artificial elimination" tests have all been eclipsed by phenolsulphonephthalein.

Intravenous injection of indigocarmin for meatoscopy has a definite value.

THE IMPAIRED RENAL FUNCTION

With these postulates granted let us survey the two striking characteristics of the impaired renal function. These are:

Diminished excretion of solids.

Lack of flexibility.

DIMINISHED EXCRETION OF SOLIDS

Excretion of excrementitious solids in watery solution is the cardinal function of the kidney. The gravity of any disease of this organ is measured best in terms of lack of efficiency in this, its excretory function. But this function is a very complex one. No test or combination of tests measures it with precision. Yet, as already noted, impairment of excretory function by infection is measured with a fair degree of accuracy by the excretion of urea (a little less accurately by specific gravity, a little more so by urine and blood nitrogen and freezing point), and by the phenolsulphonephthalein test.

Urea Estimation.—So overshadowed is urea by phenolsulphonephthalein that there is a general tendency on the part of urologists to omit altogether the collection of 24-hour specimens of urine for quantitative tests. But the 24-hour specimen should be depended upon for two data: viz., the total quantity of urine passed, and the concentration and total quantity of urea.

The total quantity of urine, if between 1,000 and 2,000 c.c., does not tell us much; but it exceeds these limits only because of an unusual excess or diminution of the intake of fluids, excessive perspiration or an impairment of kidney function.

Pathological oliguria may mean obstruction to the outflow of

urine, acute congestion of the kidney (as in acute Bright's), or grave chronic impairment of kidney function. These conditions may be readily distinguished by collateral investigation.

Polyuria is characteristic of certain types of chronic renal congestion, as in tuberculosis, stone, prostatism, retention (q. v.). The polyuria of nervousness, of arteriosclerosis, and other nonsurgical conditions do not concern us.

The total quantity of urea passed for 24 hours should exceed 45 gm. (50 gm. is regarded as normal). Physiological variations in the total urine do not materially affect the total urea. But disease of the kidney reduces it. The diminution of total urea is not, however, a good index of renal disease. Neurasthenia, for instance, may reduce it to 30 gm., or even less.

The concentration of urea (gm. per liter) is in one sense an indication of health. For the diseased kidney shows its reduction of function very largely by its inability to excrete solids. Hence the concentration of urea by a diseased kidney is always relatively low. There are many physiological agencies that interfere with urea concentration. Thus a very dilute urine may be passed as the result of nervousness, or of drinking large quantities of fluid, or of arteriosclerosis, quite independently of the condition of the kidney itself. Hence *lack* of urea concentration is *no* evidence in itself of disease of the kidney. On the other hand, the *presence* of urea concentration *is* an evidence of health of the kidney. A urea concentration of more than 18 or 20 gm. to the liter is evidence of a sound kidney.[1]

But urea estimation of the specimens obtained separately from the two kidneys by the ureter catheter is of the greatest value. The urine passed simultaneously by two normal kidneys should show a urea concentration which is either absolutely equal or varying not more than 5 per cent (i.e., 1 gm. in 20). But urea variations are subject to unaccountable physiological changes and are in general less marked than the corresponding variations in phenolsulphonephthalein output.

In view of the inaccuracy of quantitative ureter catheter findings it is prudent to consider urea percentage [2] much more accurate than urea volume or phenolsulphonephthalein percentage. If they all agree, or if the urea volume or the phenolsulphonephthalein percentage vary in the same sense, but to a different degree from urea percentage, the accuracy of the observation is confirmed. But if they disagree, we

[1] Yet a patient of mine died of acute renal congestion 53 hours after nephrectomy, having passed about 600 c.c. of urine, one portion of which showed a concentration of urea amounting to 33 gm. to the liter.

[2] Which is the only observation not vitiated by the leakage of urine alongside the ureter catheter.

may have grave doubts as to whether some technical error has not vitiated our conclusions.

Indigocarmin.—Indigocarmin should never be injected in suspension, as is usually done. Furness has shown that 10 c.c. of a saturated solution (0.6 per cent) injected intravenously appears in the urine from a normal kidney within six minutes and colors the urine a deep blue or green for less than half an hour thereafter. Hence in case the ureter mouth cannot be found or the ureter cannot be catheterized, the dark stream of urine shows the position of the ureter mouth, the regularity and force of ureteral peristalsis and, with relative accuracy, the efficiency of the kidneys (measured by the relative darkness of the ureteral jets). The cystoscope should not be introduced until the dye has been injected and is visible in the urine. If the ureter is thus found and catheterized, phenolsulphonephthalein may be injected and its output estimated. For alkalinization of the urine decolorizes the indigocarmin.

Indigocarmin is not so convenient, and probably not so accurate, as phenolsulphonephthalein for mathematical estimation of impairment of the kidney function.

Phenolsulphonephthalein.—It has been objected that no artificial elimination test can equal urea estimation of kidney function because the kidney naturally eliminates urea, and does not naturally eliminate other substances. The only answer to such an argument is that the wide experience of many observers has led to an almost unanimous consensus of opinion to the effect that the phenolsulphonephthalein output usually gives more accurate evidence of kidney function or impairment of function than any other test. We repeat that this refers only to surgical cases. The phenolsulphonephthalein test is notoriously inaccurate in medical cases.

The test was introduced by Drs. Rowntree and Geraghty.[1] The apparatus required is a 6 per cent solution of phenolsulphonephthalein; this is sold in 1 c.c. ampules. One also requires a colorimeter. The Dubosc colorimeter is much the most accurate; but its readings are unnecessarily accurate, i.e., the reading is more precise than is warranted by the test. The Dunning colorimeter, though it permits errors of two or three per cent in the reading, is cheaper than, and fully as accurate as, any other for practical purposes. The Hellige colorimeter, though practically no more accurate, is more expensive.

The kidney function of a healthy person, known to empty his bladder, is estimated as follows: 1 c.c. of the solution is injected into the muscle of the lumbar or gluteal region. The time of injection is noted precisely. Ten minutes later the patient is made to urinate.

[1] *Jour. of Pharmacol. and Exp. Therap.*, July, 1910. Cf. also Keyes and Stevens, *Am. Jour. of Urol.*, Oct., 1911, vii, 367, and *N. Y. Med. Jour.*, June 1, 1912.

If the renal function is normal the phenolsulphonephthalein output will have just begun, and the urine (if acid) will be of an abnormally bright yellow color. The addition of a few drops of sodium hydrate solution, or other alkali, to this urine changes its color to a bright cerise.

One hour later the patient urinates again. This urine is diluted to 1 liter and a few drops of 5 per cent sodium hydrate solution added to it render the urine alkaline and bring out the cerise color. The urine is then poured into the ampule provided, and measured in the colorimeter. At the end of a second hour the patient urinates again, and the urine thus obtained is alkalinized and measured in the same way.

It will be found that the normal kidney begins to excrete phenolsulphonephthalein within ten minutes, eliminates at least 40 per cent of the amount injected within one hour (usually 50 per cent or more), and in the second hour 10 or 20 per cent more. The normal total for two hours is at least 50 per cent; it is usually 60 to 70 per cent, and may rise as high as 80 per cent. Rowntree and Geraghty insist that the patient shall drink several glasses of water during the test. This has the advantage of filling the bladder with enough water to insure the patient's ability to urinate at the end of each hour.

The following precautions are to be noted in reference to pathological cases:

1. If the urine contains much pus it will become very ropy on addition of the alkali. Therefore the alkali should not be added until after the urine has been diluted. The dye is diluted with the urine, and the resulting ropiness does not interfere with the correct estimation.

2. Blood in the urine is a rather serious impediment to exact estimation. Nevertheless, if the urine is permitted to stand for a while before being diluted, the blood corpuscles will settle to the bottom of the glass, and the supernatant fluid may then be used with a fair degree of accuracy.

3. If the patient does not empty his bladder, it is of course necessary to catheterize.

4. If the output of phenolsulphonephthalein is much delayed, it may be found that it does not appear in the urine at all for half an hour or even an hour after injection (even longer delay sometimes occurs, but in that case the total output in any one hour is never more than a trace). In such cases the output for the first hour is usually approximately the same as that of the succeeding hours. Most exceptionally the kidneys delay the output of phenolsulphonephthalein as long as an hour or so and then excrete a relatively high percentage (as much as 35 per cent even) in the first hour, and very little in the succeeding hours. In such cases the delay in output of phenolsulphone-

phthalein is not nearly so significant of bad function as the ability to concentrate the drug, when it is excreted, is evidence of good function. Consequently in such instances it is well to repeat the test, if it has been done by the routine method, watching for the precise moment of excretion, and measuring the first hour from that time.

Phenolsulphonephthalein estimations are, of course, comparable not to percentages of urea, but to total urea, i.e., to the amount of urea excreted in grams during a certain period. Thus we must always bear in mind that quantitative inaccuracies in the amount of urine passed (such as result for instance from retention of some urine in the bladder or, when the ureter catheter is employed, from extra-catheter flow) introduce no inaccuracy in the estimation of urea percentage, but do introduce an unknown element of inaccuracy in the estimation of total urea and of phenolsulphonephthalein percentage. Thus the urea percentage is that estimation which is the freest of all from the element of technical error. But, apart from technical errors, the phenolsulphonephthalein output is more sensitive than the urea percentage. On the other hand, phenolsulphonephthalein does rather magnify the loss of kidney function, and exceptionally the phenolsulphonephthalein output is very low although the kidney function is seemingly little impaired. I have, for instance, reported [1] a case of urethral stricture who entered Bellevue Hospital in acute retention. I promptly performed perineal section without a guide under ether. The next day, and several times during the next few weeks, he excreted only a trace of red in twenty-four hours. Yet he had no untoward symptoms. He remained in the hospital for a number of months. During that time he was twice given a spinal anesthetic, once for a Cabot resection of the urethra, once for a Chetwood operation on the neck of his bladder, and finally the resulting fistula was closed under a local anesthetic. Yet during all this time he never showed more than 5 per cent of phenolsulphonephthalein in one hour, and during the greater part of the time he passed but a trace of the drug in the first twelve hours after its injection.[2] Such a low phenolsulphonephthalein output is usually prohibitive of surgical interference. But the case is cited as showing that in some instances one may disregard a low phenolsulphonephthalein output if all other signs point to a favorable general condition (and especially if the blood urea is low).

Although the phenolsulphonephthalein output is expressed accurately in figures, these figures do not read the same for one case as for another. The patient is a human being, not an inanimate object. Other things must be taken into consideration as well as the phenolsulphonephthalein output.

[1] *Am. Jour. of Urol.*, 1912, viii, No. 11.

[2] He was alive and at work two years later.

Beer has suggested that operation may be safely performed upon persons with a very low phenolsulphonephthalein output if it can be shown that the gravity of the lesion in one kidney is much more marked than that in the other. In this case the lowered phenolsulphonephthalein from the relatively normal kidney is but a reflex phenomenon which might be safely disregarded in certain cases that appear to be otherwise in good health. I should gravely doubt my ability to apply such a rule in practice with any degree of success. Not only have I operated upon persons with extremely low phenolsulphonephthalein output, but I have seen at least one patient die of acute renal congestion immediately after operation although the phenolsulphonephthalein before operation had been high. In this case, the high output before operation was justified by the post mortem appearance of the kidney, but the shock of operation was too much for the patient to bear.

Such exceptions in the interpretations of the phenolsulphonephthalein output will continue to occur. They are due to two factors. The test itself doubtless fails to indicate the precise general renal function in certain surgical cases, just as it does in many medical cases. But the more usual reason for its failure is that the surgeon's question is not—what is the kidney function at the present time but rather, what will the kidney do if I operate?

This question involves many elements that no single test can cover. It is a question that can only be answered out of the broad experience of the surgeon. The phenolsulphonephthalein test forms, for many of us, an essential element in this answer. A high output of the dye is most reassuring; a low output may be due to errors of technic, to disease in the kidney or to obscure causes that we cannot understand. But in many cases of obscure surgical disease of the kidney, the marked lowering of phenolsulphonephthalein output is the only clear indication that the kidney is gravely impaired, and will doubtless not withstand the shock of general anesthesia and operation. One of the chief functions of the phenolsulphonephthalein test is therefore to act as a danger signal. Though what has just been said suggests the peril of attempting a too precise definition, the following figures may be accepted as roughly accurate.

In one hour after the onset of phenolsulphonephthalein excretion following intramuscular injection 40 per cent or more is a normal excretion; 25 per cent or more shows moderate impairment of function; if less than 20 per cent is excreted in one hour, the impairment of function is probably very grave. A low excretion, due to tuberculosis or to acute renal congestion (notably that due to the institution of catheter life in prostatics), is particularly ominous. But a chronically low output, as in the case mentioned above, is simply a sign to beware.

Phenolsulphonephthalein with the Ureter Catheter.—It will be noted that no mention has been made of intravenous injection of phenolsulphonephthalein as a test of kidney function. Intravenous injection presents no advantages for routine work, and many disadvantages, for it concentrates the output so much as markedly to increase the possible technical error.

But other considerations control our choice of method when employing the ureter catheter. In the first place, speed is imperative, both out of consideration to the patient, and because the ureter catheter so readily becomes occluded. Moreover many perfectly normal persons exhibit, as physical evidence of the nervous shock due to cystoscopy, a marked nervous polyuria. This polyuria is associated with a marked inhibition of the excretion of solids. Under such circumstances, the normal kidney may excrete only a trace of phenolsulphonephthalein if the drug is injected intramuscularly. Intravenous injection overcomes this inhibition by the greater concentration in which the dye is presented to the kidney. Hence *intravenous injection should always be employed in connection with ureter catheterization.*

The normal onset of excretion after intravenous injection and measured by ureter catheter is from 2 to 6 minutes; but the intervention of the catheter so multiplies the possibilities of technical error that the time of onset is merely a point from which to begin the collection of urine for phenolsulphonephthalein estimation. Delay in output beyond 9 minutes is rather unusual even when the function of the kidney is impaired.

There are certain advantages in taking the phenolsulphonephthalein estimation simultaneously from each kidney regardless of whether the time of output is markedly delayed in one of them or not. For if the marked delay is not due to stoppage of the catheter or extracatheter flow it may well be counted as evidence against the function of that kidney. I have always made the estimation simultaneously on this account.

The duration of the collection of phenolsulphonephthalein by ureter catheter should be sufficient to give us the information we require. If the output is immediate and strong from each kidney, the experienced observer will sometimes consider 5 minutes long enough for all his needs. I usually collect the urine for 10 or 15 minutes, personally supervising the action of the ureter catheters throughout this time, so that I may have some notion of the probable amount of extracatheter flow. This is also checked up by measuring the amount of urine obtained from each catheter, and noting the phenolsulphonephthalein content of the urine in the bladder at the moment that the ureter catheters are withdrawn.

Each normal kidney excretes at least 1 per cent of phenolsulphone-

phthalein per minute for the first 20 minutes after the appearance of the dye in the urine following intravenous injection.

The test as thus applied is much more sensitive than urea estimation, and will be found to vary much more widely. For instance, a hydronephrotic kidney during the 15 minutes after its normal fellow had begun to excrete the dye, excreted no phenolsulphonephthalein whatsoever. Yet the urea percentage in the urine excreted by this kidney was 0.8 per cent.

The relative merits of the more sensitive phenolsulphonephthalein or the less sensitive urea are scarcely worth arguing. The errors and disturbances incident to cystoscopy are such that the only thing mathematically certain in the quantitative analysis of specimens of urine obtained by ureter catheter is that these specimens represent neither the normal nor the total function of that kidney during a given space of time.

The object of employing the phenolsulphonephthalein test with the ureter catheter is to obtain ready confirmation of the conclusions derived from microscopic analysis and urea estimation of the urines obtained separately from the two kidneys. The most dependable features of the urines thus obtained are the micro-analysis for pus and bacteria, and the estimation of urea per cent. But the added volumetric estimation of total quantity of urine, total quantity of urea, and percentage of phenolsulphonephthalein, strengthen our impression in otherwise doubtful cases. When they disagree, and the disagreement is not plainly explicable on grounds of technical error, the ureters should again be catheterized.

LACK OF FLEXIBILITY

Barringer has justly observed that the tests for renal function are actually tests of the reserve force of the kidney; a reserve upon which the surgeon usually intends to draw to withstand the shock of operation. Power to take on extra work (flexibility in other words) is, therefore, one of the striking characteristics of the normal kidney function. This flexibility is manifested in changes from hour to hour, indeed from minute to minute, in the quantity and quality of the urine. The diseased kidney shows a marked diminution in this flexibility. Such ordinary influences as eating and drinking, perspiring, etc., excite a change in the quality and quantity of its output much less than that of its normal fellow. This lack of flexibility has been made the foundation of various tests of renal function, notably the experimental polyuria test of Albarran.[1] He collected the urine for four half-hour periods, administering three tumblers of water at the end of the first period.

[1] "Exploration des Fonctions Rénales," 1905.

The result of his test may be plotted in very pretty curves, but its accuracy by no means compensates for the length of time consumed.

Yet the following observations of Albarran are noteworthy:

"If instead of comparing the total quantity of urine excreted during a certain time, we compare the urine in a series of fractions of this time, we shall be studying the actual functional activity (*marche fonctionelle*) of the two kidneys. If, for example, instead of collecting the urines for three hours, and comparing the total excretion of the two kidneys during that period, we divide these three hours into six half-hour periods, and thus compare six specimens from each kidney, we can plot out a curve for the diseased kidney and another curve for the healthy kidney. By comparing the progress of elimination from each kidney, as shown in these curves, we acquire some very important data since we know that the curve of excretion in a kidney is flattened in proportion to the disease of that kidney."

Such prolonged observations are not necessary. But just as the routine urinalysis of ureter catheter specimens may be certified to by the phenolsulphonephthalein output, so the variations in the kidney function, as measured over periods as short as 15 minutes each, may be taken into consideration in estimating the functional capacity of a kidney.

We make this comparison tacitly, at least, every time a phenolsulphonephthalein test is made without ureter catheterization. For in measuring the excretions for the first and second hour separately (as should always be done) we note not only that a high excretion in the first hour is likely to be followed by a very low one in the second, but that lowering of the first hour excretion heightens that in the second hour only up to a certain point. Thus if the first hour excretion falls as low as from 10 to 25 per cent, the excretion in the second hour is likely to fall within the same figures. But if the first hour excretion falls below 10 per cent, that in the second hour does not correspondingly increase. On the contrary, it tends to fall in precisely the same ratio as that of the first hour so that the differences in excretion hour by hour when the first hour's excretion is below 10 per cent is very slight indeed. In other words, the grave impairment of the kidney function shows itself not only by reducing the initial output of phenolsulphonephthalein, but by keeping that output very close to the same level until all the dye is excreted.

The same observation may be made in reference to urea output. The gravely impaired kidneys of prostatics, for instance, excrete about the same percentage of urea day in and day out, year in and year out. The kidneys are all the while working at top speed. If an extra strain is put upon them, as exemplified by the injection of phenolsulphone-

phthalein, they cannot handle the business at hand promptly, but must divide it up and gradually dispose of it.

Since surgical kidney diseases usually destroy the tubular epithelium rather than the glomeruli considerable, nay very marked, variation in water excretion may be observed from kidneys that show every other evidence of a gravely impaired function.

Thus the lowered ability to excrete solids, and the lack of flexibility in the kidney function are but different phases of the same physiological phenomenon. Each is of assistance in estimating impairment of the kidney function.

TECHNIC OF RENAL FUNCTION TEST WITH THE URETER CATHETER

The routine I prefer is the following:

If there is question of hemorrhage from the kidney, no instrument is passed into the ureter until the precise nature of each urinary jet has been carefully studied. If the wax-tipped catheter is to be employed, this is passed before the ureters are catheterized. If any difficulty in finding the ureter mouth is anticipated inject 5 c.c. of a saturated (0.6 per cent) solution of indigocarmin, and do not introduce the cystoscope until this appears in the urine. Finally the ureter catheters are introduced, and the cystoscope is held in place until one is certain that the catheters are working well. The first 20 to 30 drops are permitted to escape in order to assure uncontaminated urine. Then with the cystoscope still in place at least 0.5 c.c. of urine is collected from each kidney for microscopic examination, the character of the jet being meanwhile noted as evidence of pelvic or ureteral dilatation. The specimens thus obtained are then set aside, the cystoscope withdrawn, 1 c.c. of phenolsulphonephthalein solution injected into a vein, and a second set of specimens meanwhile collected for urea estimation by the hypobromid method. From time to time, after a lapse of two minutes, a drop of urine from each catheter is permitted to fall into a white pus basin containing a few drops of sodium hydrate solution until the red color appears in the urine. The ureter catheters are then transferred to a third set of specimen bottles, care being taken to note the time of appearance of the dye in the urine of each kidney, and an effort being made to estimate whether undue delay in one side is caused by inefficient action of the catheter, or of the kidney. In deciding this point, the concentration of dye in the urine is a most important factor. For if there is delayed output on account of kidney inefficiency the concentration of the dye is sure to be low. While if the delay is due to catheter inefficiency, when the dye

does appear it is in considerable concentration. Specimens for phenolsulphonephthalein estimation are then collected for 10 or 15 minutes, depending upon whether the findings seem likely to prove obvious or doubtful. Finally a fourth pair of specimens may be collected for bacteriological examination if this is to be made by culture.[1]

[1] The order of procedure above described is the one calculated to give the best results. The first specimen obtained should be used for microscopical analysis because it is likely to contain less ureteral epithelium and blood than any of the subsequent specimens. On the other hand, this first specimen may be contaminated with pus from the bladder. If there is any question of this, a microscopical examination of specimen No. 2 should be made. Specimen No. 2 is essentially for urea estimation. This may be compared with Nos. 1 and 4, after these have been centrifuged, thereby getting a series of observations that may be of advantage in estimating changes in the kidney flexibility.

Conclusions derived from this series must, however, be taken with a grain of salt for the first specimen is very likely not only to be contaminated by the urine from the bladder, but also to show the effect of reflex inhibition due to cystoscopy. Finally the reason for taking the specimens for culture last is, not only that these are the least likely to be contaminated from the bladder, but also because any antiseptics in the ureter catheter are most likely to have been washed away.

My catheters are so strongly formalized that I find it necessary to delay the culture specimens to the last, and also to drop them immediately into culture tubes; otherwise the formalin kills the bacteria before they can be transferred to the laboratory.

CHAPTER IX

RADIOGRAPHY

It is not my province to instruct the radiologist how to obtain good pictures of the urinary tract. This can be learned only by long experience. Some radiologists obtain good pictures but interpret them rashly and inaccurately. Others get faint pictures, but interpret them with extraordinary skill. The radiologist who can be depended upon to obtain good pictures, and to interpret them with discretion, is as rare a treasure as the good diagnostician in any other branch of medicine.

Obedience to the following rules is essential to success:

1. The best pictures are obtained in the morning after the patient has taken an ounce of castor oil the night before, and a low saline or soapsuds enema immediately before the picture is taken.

2. The whole urinary tract should be covered no matter what the preliminary diagnosis. Better results are obtained by using three to five small plates, rather than one large one. The urinary tract extends from the tenth rib above to the pubes below.

3. A good picture of the abdominal portion of the urinary tract should plainly show the tips of the ribs and of the transverse processes, and the border of the psoas muscle. If the diameter of the patient is no more than twelve inches, or if he is not so lean as to be bereft of perirenal fat, such a picture should at least suggest the outlines of the kidney.

4. A good picture of the bony pelvis should plainly show the tip of the coccyx, and of the iliac spines. The tube should be placed so high as to bring the prostate within the field of vision above the pubic bone.

5. All plates should be taken in duplicate, and stereoscopically.

PROSTATIC CALCULI

Prostatic calculi always contain a large percentage of lime, and apparently always show in the x-ray plate (Pl. III). They appear as a group of dots occupying the regions of the lateral lobes of the prostate. The larger prostatic stones may reach such an extraordinary size

as to be mistaken for vesical calculi. I have several times known prostatic and vesical calculi to co-exist. In some instances the vesical calculus is shown by the x-ray (Fig. 27), in others not. The differential diagnosis is made by cystoscopy.

VESICAL CALCULI

In the diagnosis of bladder stone the cystoscope stands first, the searcher second, the x-ray third, in point of accuracy. Stones originat-

Fig. 27.—Radiogram Showing Bladder and Prostatic Calculi.

ing in the bladder are so often bereft of lime salts as to show very badly in the x-ray. It is to be noted that small stones often lie to one side of the median line, and sometimes even give the impression of being in the ureter (Figs. 29 and 30).

Stones in the bladder, otherwise invisible, may be shown in the

FIG. 1.—SMALL PROSTATIC CALCULUS JUST ABOVE PUBES. Bilateral ureteral calculus had been suggested by the shadows of the calcified iliac arteries.

FIG. 2.—LARGE GROUP OF PROSTATIC CALCULI. Rectal examination had led to a diagnosis of prostatic carcinoma. No symptoms beyond a slight frequency and discomfort with urination.

PLATE III

Fig. 28.—Vesical Calculus; Phlebolith in Region of Pelvic Ureter

Fig. 29.—Vesical Calculi.

x-ray after injecting air into the viscus, or sometimes after coating them with collargol. These devices, however, are scarcely worth resorting to since cystoscopy shows the stone, and many other things besides.

URETER CALCULI

The characteristics of ureteral stone as revealed by radiography are the following:

They are never spherical; they are usually oblong; in consistency they are not irregular and motheaten; they may be found in any portion of the ureter, but are most common near its two extremities.

The presence of stone in the ureter may not be disclosed by the x-ray, either because the shadow of the stone is overlaid by that of bone, feces, or other solid matter or—we know not why. Cabot has called attention to the frequency with which stones are overlooked in the region of the sacro-iliac synchondrosis and has shown that by arching the patient's back over a pillow and taking the picture at the extreme of obliquity with the tube over the patient's chest, and the plate under the buttocks, the ureters may be drawn clear of the shadow of the pelvis, and stones, otherwise invisible, may be seen. An unusually good x-ray will, however, show a stone even through the pelvic bones.

The second reason for invisibility is no reason. I have known the same radiographer overlook a stone in the lower ureter in several plates, and a few weeks later to show it very plainly. The stone was composed almost exclusively of oxalate of lime.

Differential Diagnosis of Stone in the Ureter.—The stereoscope is of great assistance in differentiating ureteral stone from other objects likely to be mistaken for this. The course of the ureters is shown in Fig. 30. In their abdominal portions they begin one or two centimeters to the outer side of the second lumbar transverse process or thereabouts, and if normal, fall almost vertically to the brim of the pelvis where they appear to curve outward slightly, and then sweep inward well to the inner side of the spine of ischium.

An oblong shadow in the course of the ureter is likely to be a ureteral stone. But such a shadow is no more sufficient evidence of the presence of stone than the absence of such a shadow is evidence of its absence. *The diagnosis of stone must be confirmed by other physical evidence, notably by the wax-tipped catheter, pyelography, or evidence of renal infection and deficient function* (Pl. IV). Ureteral stone must be differentiated from the following:

Phlebolith, or calculus in the seminal vesicle.

Tubercular glands.

Enteroliths and foreign substances in the intestines.

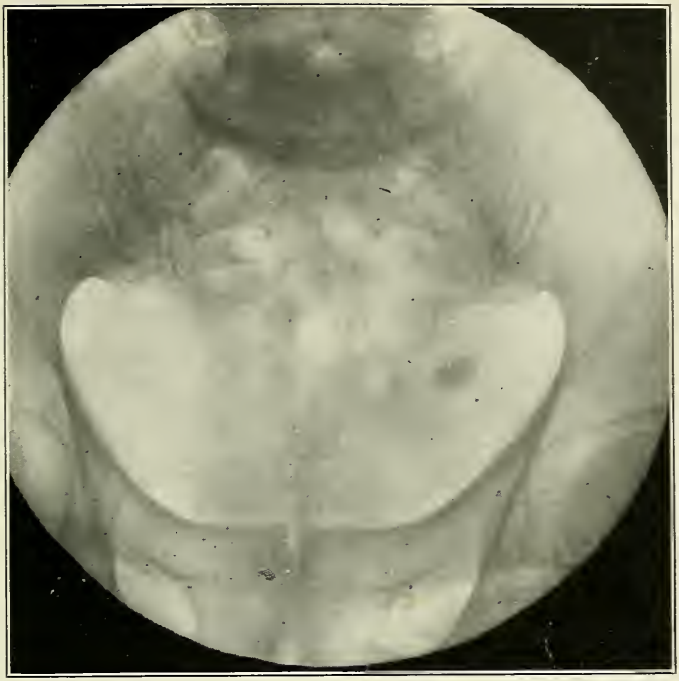


FIG. 1

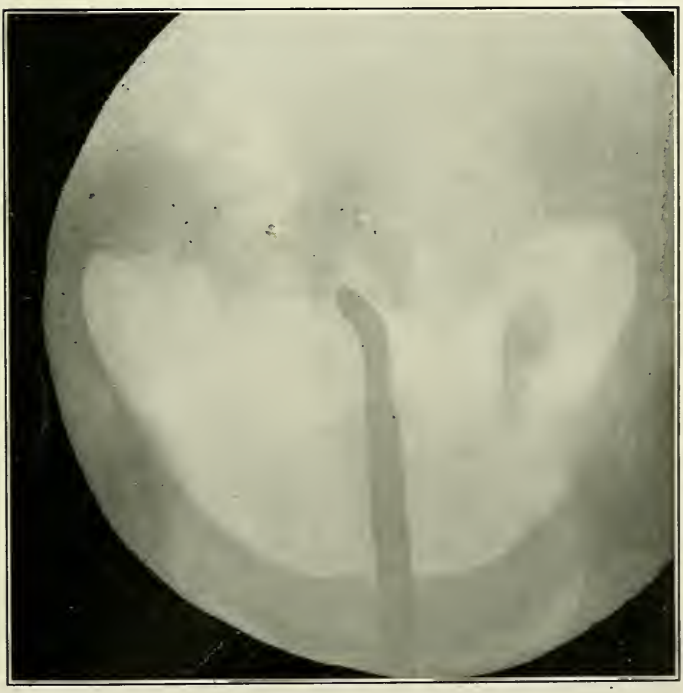


FIG. 2

FIG. 1.—Shows an oxalate stone in the lower ureter.

FIG. 2.—Shows the same stone surrounded by collargol (in the dilated ureter about and above it) injected through the ureter catheter.

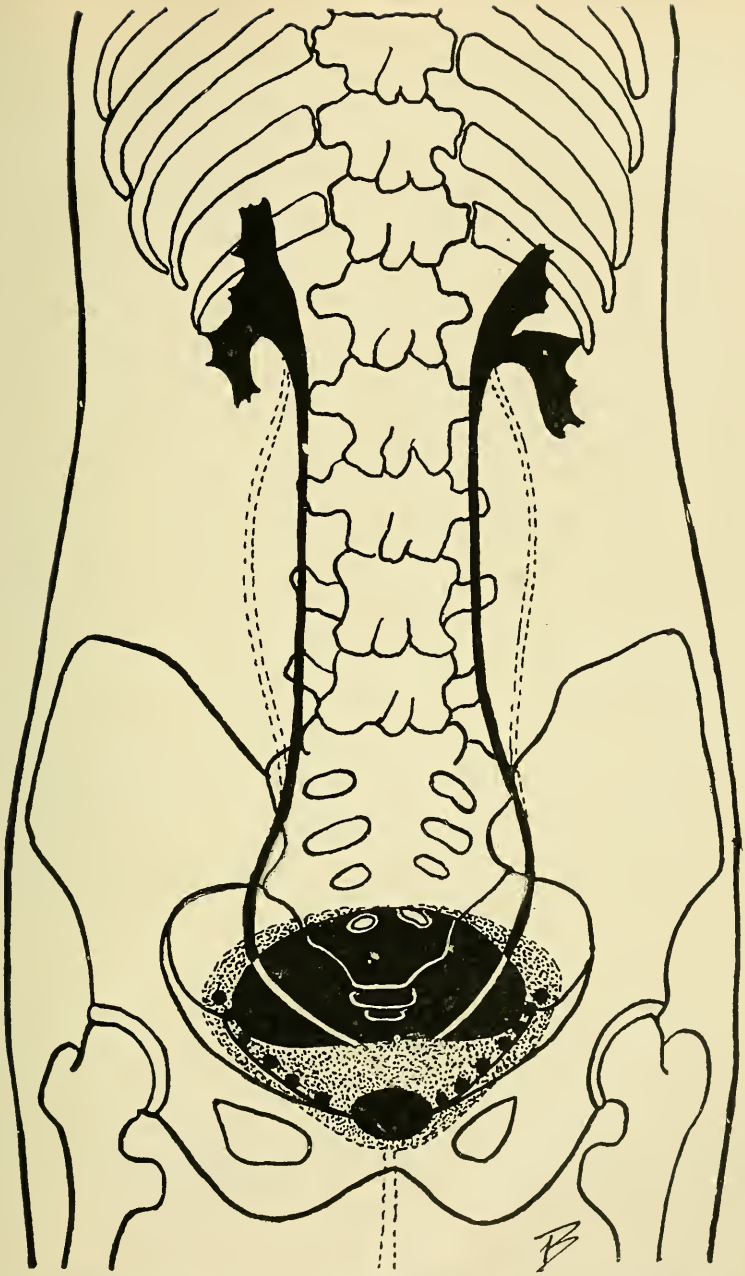


FIG. 30.—THE STONE-BEARING AREA. Over the pubes is the small oval area of prostatic calculi. From this the usual area for phleboliths runs along the edge of the pelvis (round dots). Bladder stones lie in the large black oval, high in the pelvis. The usual course of the ureters is shown in black.

Phleboliths (Figs. 28, 31) may be readily distinguished by being round and not oblong, and lying near the spine of the ischium, or below it, rather than above and to the inner side of it. In doubtful cases the diagnosis may be thus made by repeating the x-ray with the

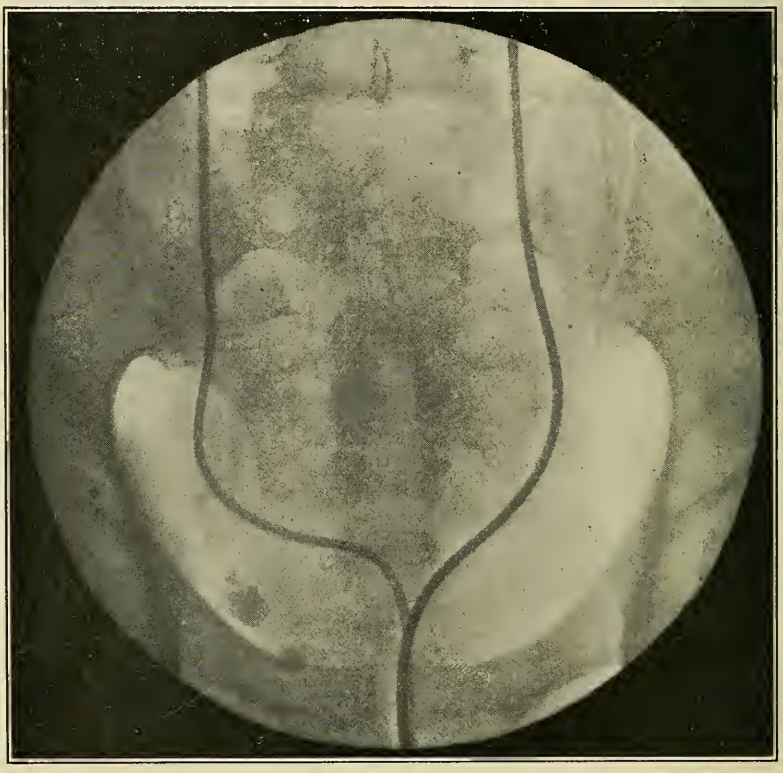


FIG. 31.—PHLEBOLITHS. The ureters are identified by visible catheters.

visible catheter in place, or by pyelography or the wax-tipped catheter.

Not so very infrequently a sclerotic artery may be seen in the region of the pelvic ureter, either as a ring (Pl. III) or a narrow ribbon suggesting a slightly dilated ureter.

Tubercular glands may well be oblong, though they are likely to be rather rounded or irregular in shape and often very motheaten in consistency (Pl. IV). In doubtful cases the diagnosis is made as in the case of phleboliths.

RENAL CALCULI

Figs. 33, 34 and 35 illustrate the situation, and various types of renal stone. It will be noted that in order to include all stones the photograph must at least cover the eleventh rib, and preferably the

PYELOGRAPHY IN THE DIAGNOSIS OF URETERAL CALCULUS.

The patient had an ancient urethral stricture and suffered from vague lumbar pain, while the urine showed mild pyelonephritis (pus, bacteria, albumin, and casts). Radiography showed what appeared to be a stone in the upper part of the left ureter and the functional tests revealed deficient function of the left kidney. Both pelves were accordingly injected with argyrol and a radiograph obtained, which showed both pelves undilated, the right ureter (left in plate) dropping normally in a straight line, while the left (right in plate) curved outward, evidently adherent to the lower pole of the kidney, leaving the shadow of the supposed stone between it and the spine. The pyelonephritis and the slight functional inactivity of the left kidney (due to ureteral adhesions) were thus shown to be due to infection from the urethral retention and not to stone.

tenth interspace. If stone is suspected, but not shown by x-ray, it may be disclosed by pyelography. This may identify the situation of the stone by showing a dilated calyx or pelvis. If the patient is again radiographed a few hours later, it is sometimes possible to see the stone coated with the silver salts which remain in the kidney pelvis.

FIG. 32.—CALCULUS IN SEMINAL VESICLE. It is identified by the finger in the rectum.

Gall-stones can usually be distinguished as round bodies, lighter in center than circumference, and situated nearer the anterior than the posterior abdominal wall (Pl. VII).

THE VISIBLE CATHETER AND PYELOGRAPHY

The visible catheter is employed to identify the position of stone or suspected shadows in the ureter and kidney pelvis. At present two implements are employed, the one a catheter, the other a bougie, each heavily coated with bismuth paint. This metallic paint renders the catheter or bougie visible to the x-ray. Therefore its introduction

into the ureter identifies its position in relation to any suspected stone (Fig. 31).

Bugbee has shown that if the visible bougie is heated it becomes extremely flexible, and can be employed, not only to identify the position of the ureter, but also to curl up in the kidney pelvis, and show its shape and position.

But we may go further than this, and inject into the ureter and

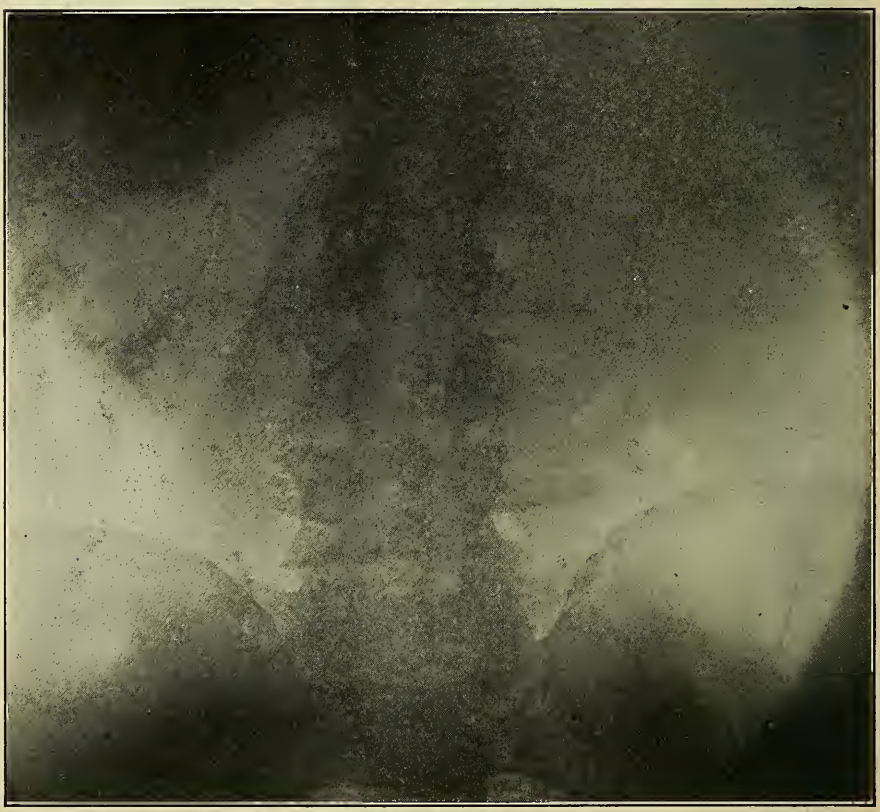
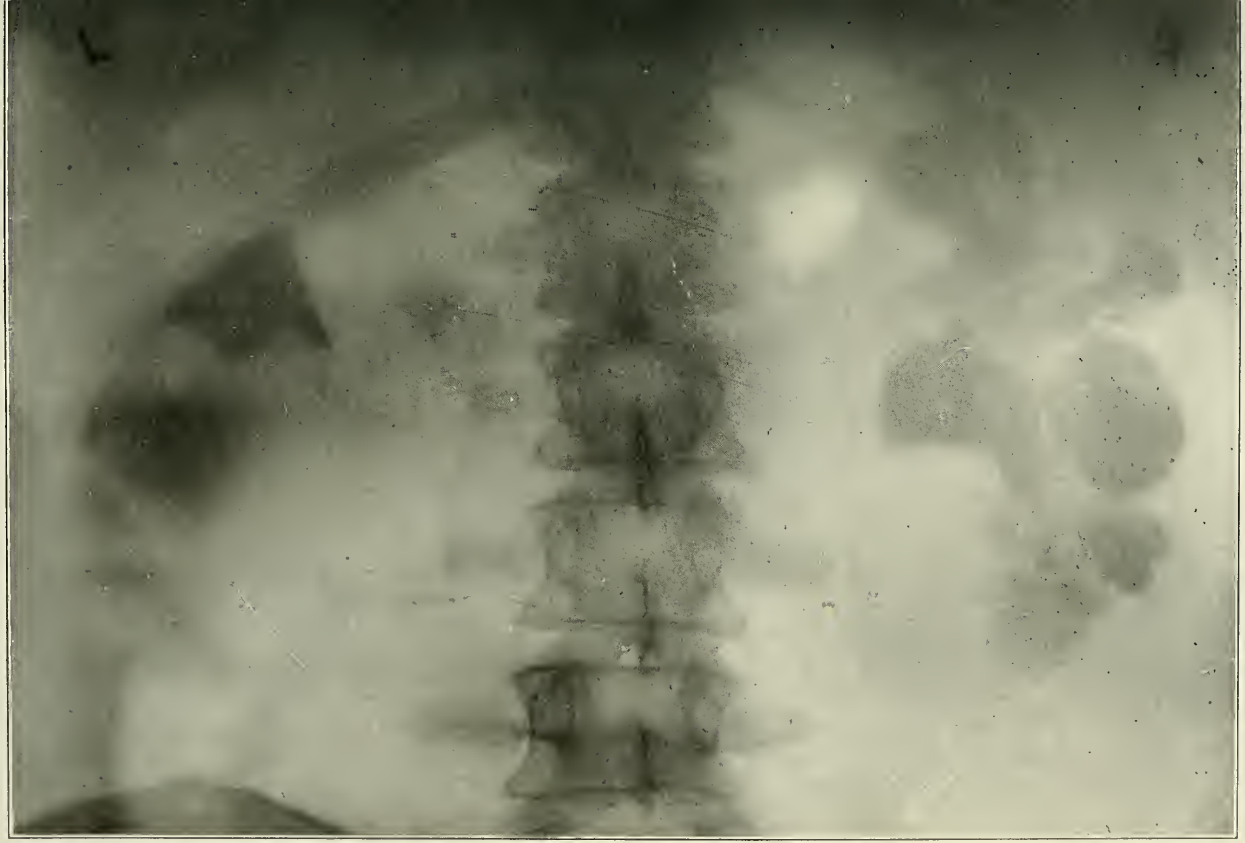


Fig. 33.—Numerous Small Oxalate Calculi in Lower Calyces of Right Kidney.

kidney pelvis a solution or suspension of some metallic salt visible to the x-ray, thus to exhibit misplacement and deformities of this portion of the urinary channel. This is pyelography (Pl. IV, also Figs. 36 and 37).

Pyelography may be performed with a number of different solutions. The chief requisite is that the solution shall throw a good x-ray shadow, and yet be fluid enough to pass in through the ureter catheter, and out through the ureter. I have frequently employed argyrol in 30 to 50 per cent solution, but the margin between a solution of argyrol so thick as to be muddy and so thin that it casts a very



Silent Bilateral Renal Calculi.

This patient passed a stone when 14 years of age. When radiographed he was 63 and suffered from prolonged hematuria due to a small, scarcely visible stone (subsequently passed, with relief of all symptoms), just below the angular stone in right kidney pelvis. The stones filling the left kidney had doubtless begun to form 50 years ago.

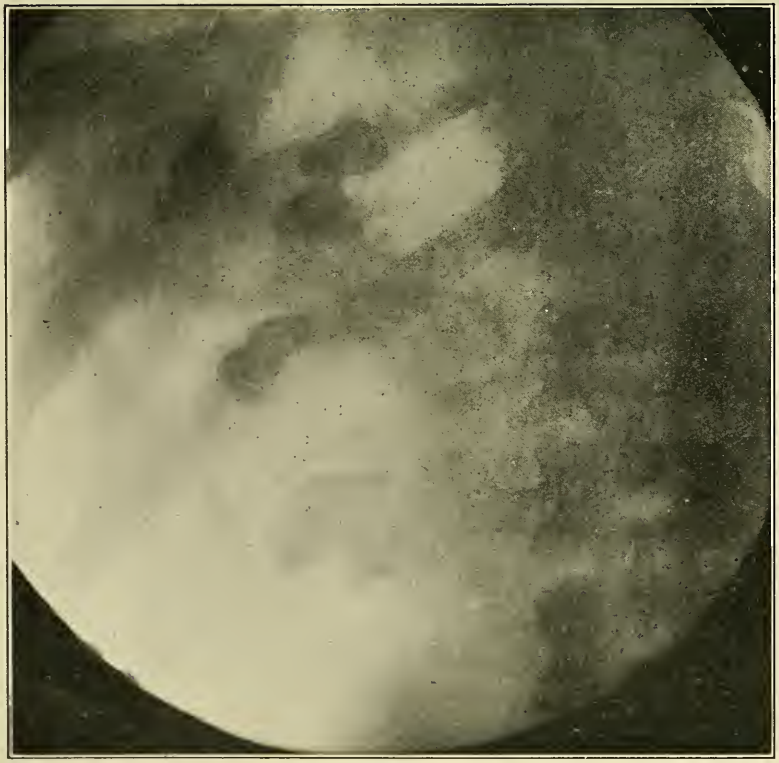


Fig. 34.—Renal Calculi. They extend from the tenth interspace to the upper border of the third lumbar vertebra.

Fig. 35.—Silent Calculus Filling the Renal Pelvis.

poor shadow, is too narrow. Bismuth emulsions are likewise too thick. Collargol in 5 to 10 per cent solution gives excellent pictures but among the deaths that have followed its injection some at least seem referable to poisoning from the collargol absorbed through the lymphatics and blood vessels of the kidney. Two among the many substitutes suggested have proven equally serviceable in my hands, viz.:

Fig. 36.—Normal Kidney Pelvis.

1. Argentide emulsion, prepared as follows (E. L. Young[1]):

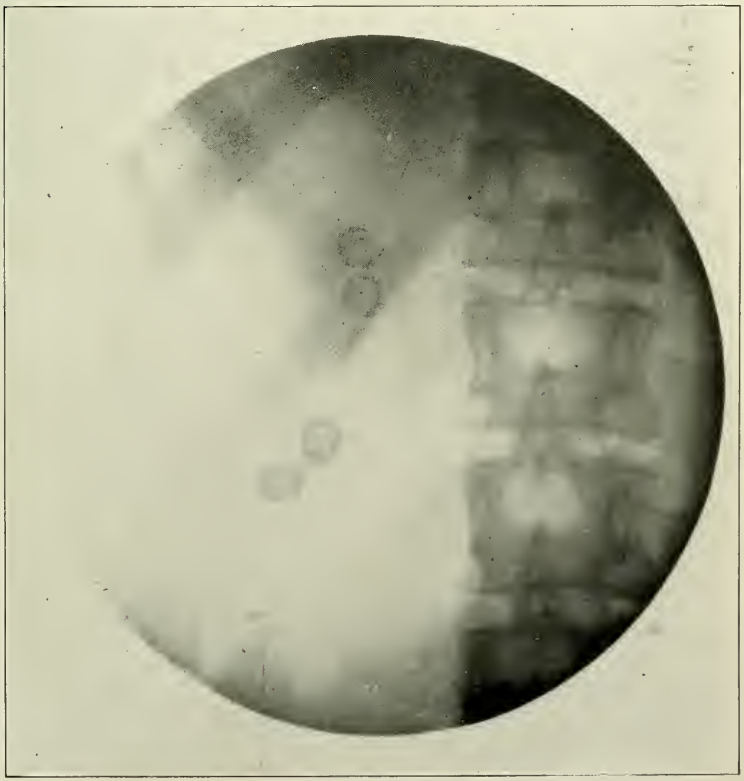
Quince seed 100 grains, water 8 ounces; macerate for 24 hours with frequent agitation; do not crush the seed; strain through cloth. Add 2 per cent boric acid up to 20 ounces. It is important to extract with water and not with the boric acid solution. Enough of this mucilage is added to 12.5 c.c. of argentide to make 50 c.c. and the mixture is vigorously shaken for two minutes—the shaking is an essential part of the process. The value of this substance depends on the mode of preparation. It keeps for several weeks.

This emulsion is irritating to the bladder but not to the kidney pelvis.

2. Ten per cent solution of thorium nitrate (Burns[2]).

[1] *Boston Med. and Surg. Jour.*, 1915, clxxii, 539.

[2] *Jour. A. M. A.*, 1915, lxiv, 2126.



Gall-Stones (Courtesy of Dr. Cole).

Dangers of Pyelography.—Pyelography is a dangerous procedure. A number of deaths have been reported as resulting from it [1] and many more are unreported. Pyelography may injure the kidney in two ways:

1. At the moment of injection it may be driven into the kidney

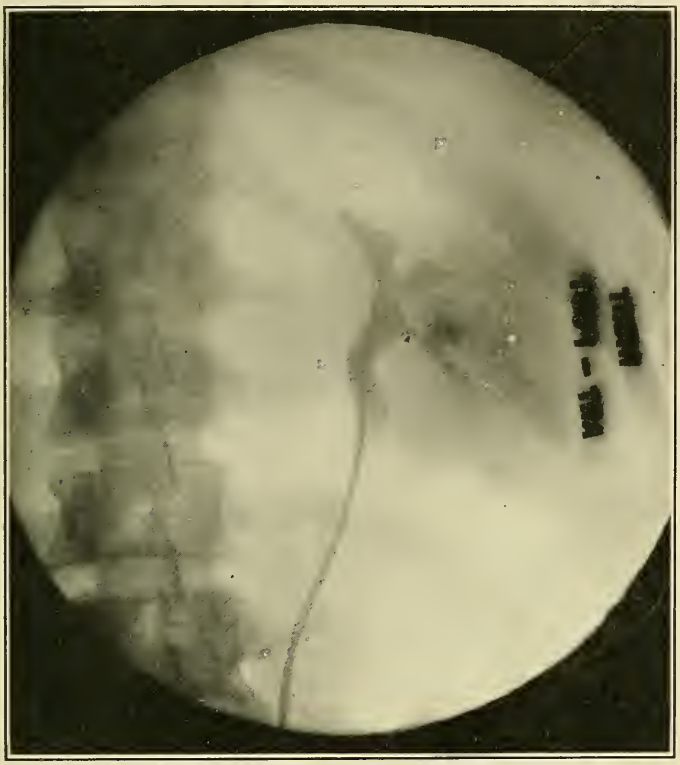


Fig. 37.—Normal Kidney Pelvis. Note visible catheter extending to upper calyx.

parenchyma, either by the force of the injection itself, or by the reaction of the kidney colic excited by the injection. The fluid is driven into the lymphatic and blood vessels about the kidney pelvis, thence it radiates through the kidney itself, making cone-shaped "infarcts" characterized by acute inflammation and degeneration.

Thence the collargol is carried into the general circulation, and excreted, both by the glomeruli of the injured kidney and that of its fellow.

Thus in the injured kidney, collargol may be found in the tubules and glomeruli, but only if the lesion has existed for a sufficient length of time to permit excretion to begin (Fig. 38).

[1] Keyes and Mohan. *Amer. Jour. of Med. Sciences,* 1915, cxlix, 30.

Fig. 38.—Damage Done by Pyelography. Microphotograph (from Fig. 39) showing collargol in glomeruli, tubules and stroma.

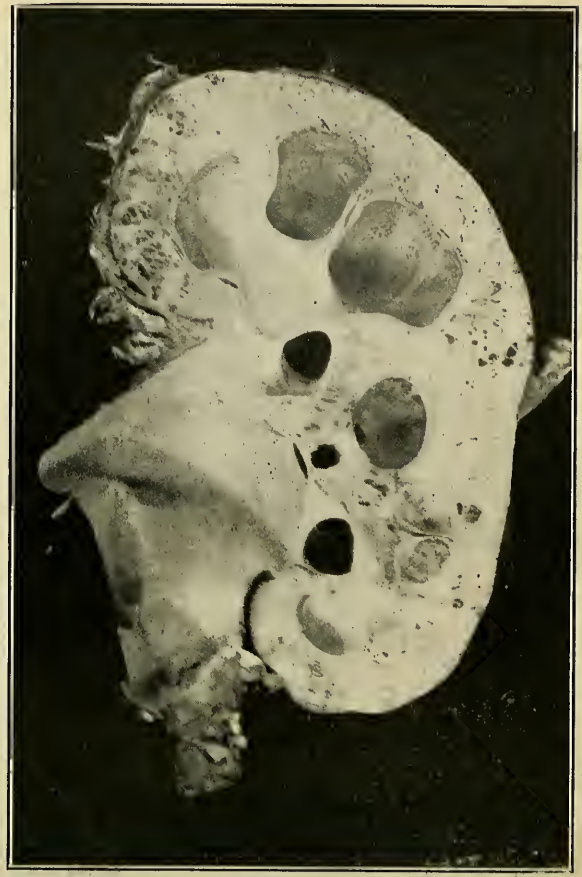


Fig. 39.—Damage Done by Pyelography. Collargol infiltration of parenchyma of hydronephrotic kidney removed two days after injection.

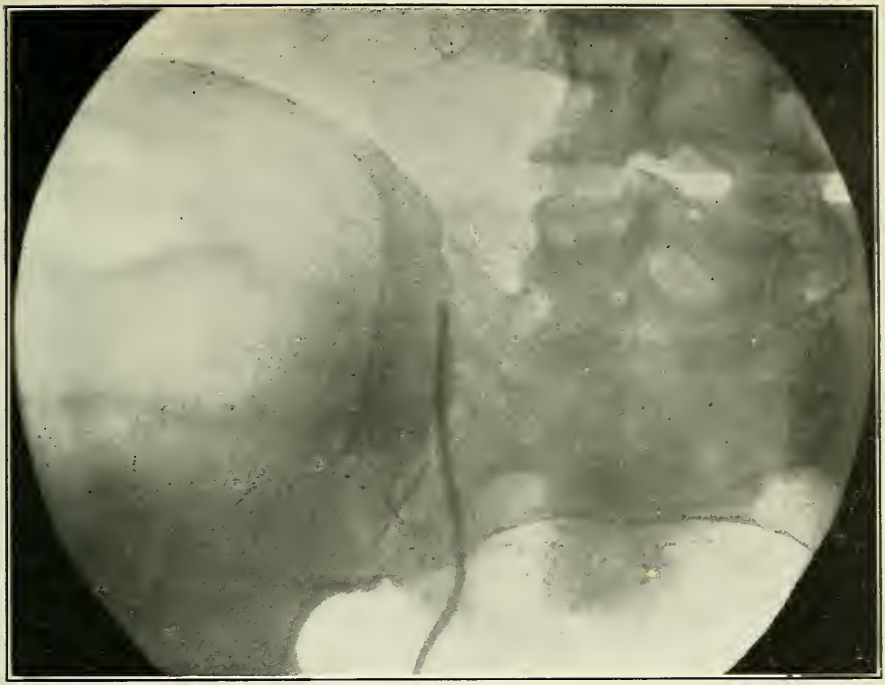


FIG. 1

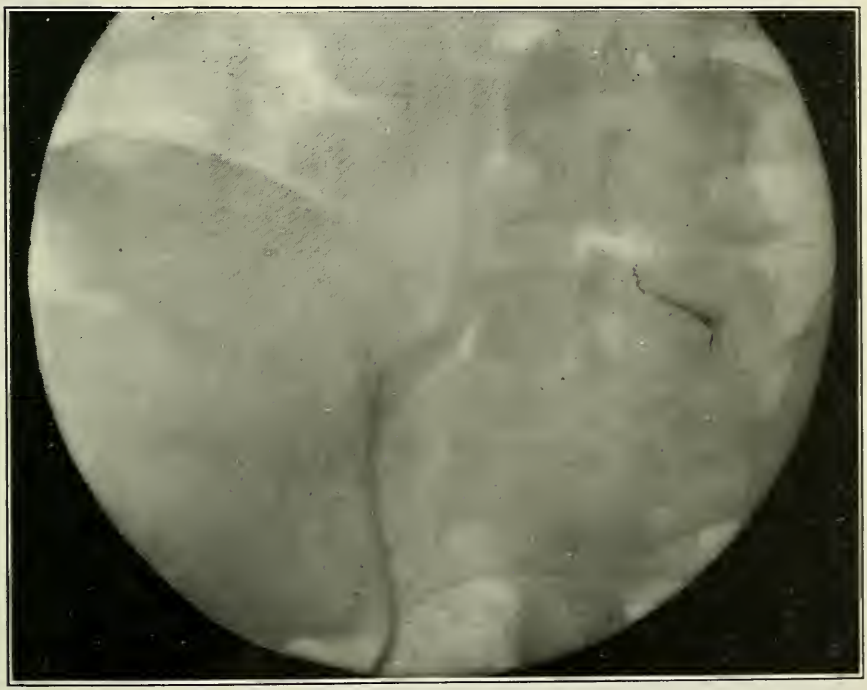


FIG. 2

VISIBLE CATHETER POINTS DIRECTLY TOWARD THE SHADOW.

FIG. 1.—Patient complained of pain in the hip. X-ray showed a suspicious shadow on tip of transverse process of fourth lumbar vertebra. Ureter catheter always stopped at 15 cm. Wax not scratched. Renal function perfect. Diagnosis: no stone.

FIG. 2.—Confirmed by injection of collargol, which showed a kinked ureter, remote from the suspected shadow.

2. Secondary, or late infiltration, may occur even without the slightest pain at the time of injection as a result of obstruction of the strictured or kinked ureter. On account of these dangers, the following rules of technic are absolute.

Technic.—1. Pyelography should never be performed excepting upon a patient in a hospital so that if acute renal retention follows the operation, the kidney may immediately be drained (Fig. 39).

2. In order to minimize the danger of renal retention, the patient should lie upon his back for at least twelve hours after the operation.

3. Advanced renal retention gives the most beautiful pictures to pyelography, but this condition can be diagnosed very accurately without pyelography and it is in this class of cases that the operation is most dangerous.

4. Pyelography is relatively safe and eminently useful in the diagnosis of tumor, stone, small hydronephrosis, and sometimes in tuberculosis.

5. The injection should always be made by gravity with the container not more than two or three feet above the level of the patient's body.

6. The capacity of the normal kidney pelvis may be as little as 2 or 3 c.c., but usually 5 c.c. may be injected with impunity. It is wiser never to inject more than 10 c.c. Leaving the catheter in to drain off the fluid is scarcely worth while unless there is ureteral retention.

CYSTOGRAPHY

The devices for making bladder lesions visible to the x-ray are much more numerous than those suggested for a similar purpose in the kidney pelvis. Thus Kelly has been able to demonstrate the size of bladder tumors by coating them with a visible fluid, and then filling the bladder with air. The size of a saccule may be roughly shown by a small ureter bougie coiled up within it.

Bladder lesions, especially saccules, usually show best if the bladder is not fully distended (usually 100 c.c.). Argentide should not be used in the bladder; it is much too irritating. Five per cent collargol, or 15 per cent argyrol, gives excellent pictures. Thorium is perhaps the most satisfactory. The usual stereoscopic pictures exhibit saccules much better than pictures taken with the tube in the median line (Figs. 114, 115; Pl. XVIII).

CHAPTER X

GONORRHEA: ITS SOCIAL ASPECTS AND PREVENTION

Gonorrhea is an acute infectious disease caused by the gonococcus. Its usual manifestation is a local inflammation of the infected surface. This inflammation is characterized primarily by redness, swelling, and exudation of pus. It extends by direct continuity and rarely by entrance of the gonococcus into the circulation. Thus gonorrhea is usually a local inflammation, rarely a general infection.

The usual portal of infection in the male is the urethra, in the female the vulva or the urethra. The disease is usually transmitted by sexual intercourse. Indirect transmission to adults by means of clothing, etc., infected with gonorrheal pus is extremely rare, both because of the relative immunity to gonorrhea of the skin and the mouth, the only surfaces with which such articles are likely to come in contact, and also because the coccus perishes as soon as the secretion containing it dries.

Infants and young children are infinitely more susceptible than adults to gonorrhea. Indirect transmission of the disease is a frequent cause of gonorrheal vulvovaginitis in little girls. I have seen but one instance of indirect transmission in the adult male.

The only other part of the body likely to be infected with gonorrhea is the ocular conjunctiva. The well-known frequency of gonorrheal conjunctivitis neonatorum is evidence of this susceptibility in infants, but the relative infrequency of gonorrheal conjunctivitis in later life is best explained by the theory that the conjunctiva of the adult has lost its excessive sensitiveness to the gonococcus. How else explain the fact that among the innumerable filthy gonorrheics who throng our venereal clinics conjunctivitis is almost an unknown complication? It is not conceivable that their immunity is due either to the cleanliness of their hands or to the fact that these dirty hands keep away from their eyes. That an adult eye is occasionally inoculated only increases our wonder that more are not.

Genitals and eyes apart, the human integument is almost immune to gonorrhea. The rectum may be inoculated by sodomy or, in the female, by drippings from the inflamed vulva. A very few instances attest the fact that the skin and the buccal and nasal mucous membranes may be inoculated.

The importance of gonorrhea to the community rests chiefly upon four factors: first, its transmissibility by sexual intercourse; second, its rebelliousness to treatment, its capacity to extend to the uttermost parts of the urinary and genital mucous membranes and its involvement, no less terrible for being rare, of the whole economy in gonococcus septicemia; third, its chronicity and latency, which deceive the patient and even his physician into the belief that the disease is cured until a new outbreak in the patient himself, or infection of a sexual partner, or, if the patient be a parturient woman, of the eyes of her child, reveals the inveteracy and virulence of the disease; fourth, the ease with which female children are indirectly contaminated, and the hospital and family epidemics resulting therefrom.

PREVALENCE OF GONORRHEA

Prevalence in the Army.—The prevalence of gonorrhea in the army of the United States is a rough measure of its prevalence in cities among young adult males. Age, temptation, and protection are approximately the same in each case.

The figures given in the Surgeon General's Report for 1908 are:

Mean enlisted strength of the army—53,803 men.

Number of cases of gonorrhea treated during the year 1907—5,782 (of whom 1,942 were in the Philippines).

Days sick—134,795.

Discharged as unfit for duty—58.

Died—1.

This means that during the year 1907 more than 12 per cent of the army had gonorrhea (in the United States 10.768 per cent, in the Philippines 18.719 per cent). The average duration of the disease was about twenty-three days.[1]

One per cent of the men diseased were discharged as unfit for duty.

Let us compare gonorrhea with other diseases. In prevalence it stands easily first, with malaria (6.319 per cent) second, enteritis and diarrhea (4.926 per cent), bronchitis (4.743 per cent), and influenza (4.046 per cent) following. In noneffectiveness (number of days sick) gonorrhea is again first (36.93 per cent), followed by the other venereal diseases, syphilis (15.367 per cent), and chancroid (14.567 per cent), and with tuberculosis (14.271 per cent) fourth. As a cause for discharge from the army, however,[2] gonorrhea (58) stands fourth to tuber-

[1] Many a case of chronic urethritis is not called to the attention of the medical officer. From infection to positive cure in civil life, the average duration is about fifty days.

[2] The detail given is "chronic gonorrhea," 21; epididymitis, 3; ophthalmia, 8; rheumatism, 20; stricture, 2; other results, 3.

culosis (177), syphilis (94), and insanity (79). As a cause of death it is insignificant; only 5 deaths due to gonorrhea are recorded in the Surgeon General's Reports for the last decade.

From these figures it is evident that the immediate results a young man may expect from a well-treated gonorrhea are an acute sickness lasting a month or so, with about one chance in a hundred of grave or permanent impairment of function, and practically no prospect of death.

But these figures do not show the chronic gonorrhea, the sterility, the prolonged infectiousness that are the really important elements in the prognosis of chronic gonorrhea in the male.

Prevalence in Civil Life.—The prevalence of prostitution and sexual promiscuity in our cities makes gonorrhea endemic among their population; smaller towns suffer in proportion to the laxity of their morals and their proximity to urban centers, while the countryside is subjected to epidemics of the disease by the return of the Prodigal Son.

In 1901, the "Committee of Seven" [1] reported that there were apparently 162,372 patients suffering from venereal disease in New York City, and of these nearly 90 per cent were gonorrheics. There were 15,969 cases of gonorrhea actually reported, of which 1,941 were in women and 488 in children. Of these children, 265 had purulent ophthalmia, 218 vulvovaginitis, 5 urethritis.

Morrow estimates [2] that 60 per cent, Forscheimer [3] that 51 per cent of the adult male population of the United States have had gonorrhea. He adds: "Twenty per cent of these young men will become infected before they are twenty-one, over 60 per cent before their twenty-fifth year, and more than 80 per cent before they pass their thirtieth year."

Among women gonorrhea, though more severe, is less common than among men. In the statistics given above the proportion of men to women is 16 to 1. It is shocking to learn that almost one-third of the reported cases of gonorrhea occurred in married women, to whom the infection had been conveyed by their husbands. Nine hundred and eighty-eight cases of marital infection were reported, and the unreported cases were believed to be six times as numerous.

Add to this the ghastly array of 488 children with ocular and gen-

[1] *Medical News,* December 21, 1909.

[2] "Social Diseases and Marriage." Also Trans. Am. Soc. Sanitary and Moral Prophylaxis, 1906, i, 18.

[3] *Boston Med. and Surg. Jour.,* Aug. 6, 1908. The statistics of gonorrhea in Germany and Austria are given by Erb (*Münich. med. Wochenschr.,* 1906, liii, p. 2329, and 1907, No. 31) and Blaschko (*Zeitschr. f. Bekämpfung d. Geschlectsk.,* 1907, vi, No. 1). Erb's contentions are approved in *Jour. A. M. A.,* 1907, xlix, 44.

ital[1] gonorrhea. Truly the much-heralded *syphilis insontium* pales before *gonorrhea insontium!*

DURATION OF THE DISEASE

"A gonorrhea begins and God alone knows when it will end," said Ricord more than a generation since; and the aphorism is as true to-day as the day it was uttered. Where there are no glands (e. g., in the conjunctiva) gonorrhea runs an acute course and then disappears; but in the genital passages it shows a marked tendency to become chronic by causing chronic glandular catarrh and periglandular sclerosis.

From the male urethra the gonococci usually disappear within six months. Persistence of gonococci for more than eighteen months in the male urethra is exceptional. The catarrh may continue longer than this, but it is kept alight by the associated microörganisms that persist after the gonococcus has disappeared.

The exceptional case whose gonococci remain alive and at least potentially virulent for two or three years—I have known but one case to persist any longer—proves the possibility of an indefinite infectiousness.

Indeed, the infectiousness of gonorrhea in the male is comparable to that of typhoid fever. Most cases last an indefinite number of weeks and are cured. A small number continue infectious. It may be a matter of great delicacy to determine the persistent infectiousness of a given case. But this does not alter the fact that almost all are cured within a few months.

But gonorrhea in the female is a very different matter. Conservative gynecologists are entirely unwilling to set any limit to its infectiousness and are confessedly incompetent in some instances to cure it, in others to

[1] "It has been shown by a number of observers that among the poorer classes of New York City, a certain proportion (commonly estimated at 10 per cent) of female infants and young children are infected with gonorrhea, in an active or latent form, or as germ carriers. The widespread prevalence of this disease constitutes one of the most difficult problems in hospital management. No institution or hospital for children, however efficiently managed, has escaped ward epidemics from time to time. . . .

"As an example of typical conditions, the Scarlet Fever Service at Willard Parker Hospital for 1913 will be found instructive: . . .

"Three hundred and thirty out of 791 female patients on admission had sufficient evidence of vaginal infection to demand their segregation, and of these, 21 subsequently developed clinical and bacteriological evidence of the disease and were transferred to the infected wards. It is not to be understood that all of these 321 cases had gonorrheal infection even in the latent form, but experience goes to show that a large number undoubtedly did. Without prolonged and repeated examinations, causing an unjustifiable annoyance to the patients, this point cannot be accurately determined."—*Bull. N. Y. Health Dept.*, Mar. 7, 1914.

say whether it is cured or not. I have known a woman to infect her partner seven years after her own infection.

To be sure most women, like most men, recover from gonorrhea in a few months. But the exceptions in women are much more indefinite in duration, much more difficult of diagnosis, much more rebellious to treatment.

The vulvovaginitis of young children is exceedingly intractable. It commonly lasts for years.

GRAVITY OF THE COMPLICATIONS

The local inflammation, which is all that most patients see in a gonorrhea, is actually the least of its dangers.

Apart from the danger of conjunctival infection, which is common to both sexes but rare in the adult, the complications due to direct extension of the disease are different in the two sexes.

In man the complications are almost entirely under the control of the skillful physician with a faithful patient. But both are rare, and patients in the poorer classes have neither the means nor the leisure to avail themselves of the resources of medicine. Among our dispensary patients the greater number suffer the pangs of an acute posterior urethritis, and some 10 per cent to 20 per cent suffer acute epididymitis, which in perhaps one-quarter of these is bilateral and results in sterility. Chronic urethritis or prostatitis results in fully 70 per cent or 80 per cent of these cases, and severe urethral stricture in a small percentage.

Sexual neurasthenia follows gonorrhea in 5 per cent to 10 per cent of clinic cases.

Among our wealthy patients, who are well treated from the onset of their disease, epididymitis complicates less than 5 per cent, chronic urethritis and prostatitis less than 20 per cent, and stricture is altogether exceptional. But even the wealthiest patient may not be willing or able to command good treatment at the onset of his gonorrhea, so that more than half the patients treated in the office of the specialist suffer from chronic gonorrhea.

Such complications as prostatic and periurethral abscess and pyelonephritis are rare in the clinic, extremely rare in private practice.

In women, on the other hand, grave complications are common. Invasion of the uterus, the uterine adnexa, and the peritoneum were noted in 40 per cent of the women reported to the Committee of Seven.

Gonorrhea reaches the uterus in 20 per cent, the tubes in 5 per cent of cases, says Schmidt.[1]

This invasion of the female generative organs takes places either at

[1] *Zeitschr. f. Geb. u. Gyn.*, vol. xxi.

the time of infection or after the birth of the first child. For the gonorrhea may subside and become latent in the glands of the uterine cervix until pregnancy excites a congestion that increases the virulence of the gonococci. By these the child's eyes are endangered at birth, its mother's uterus and tubes immediately thereafter.

Gonorrhea of the uterus and tubes usually, though not always,[1] implies sterility. Hence this sterility is total if the wife's tubes or uterus are promptly infected; it is the so-called one-child sterility if they are infected at the time of parturition. Neisser and Bumm agree that the gonococcus causes about 30 per cent of sterility in women, while Morrow states [2] it is responsible for fully half of involuntary sterility.

But, besides depriving a woman of her children, gonorrhea may render her a permanent invalid, may even cost her her life. It is a curious fact that gonorrhea in women is either much milder or much more severe than the disease in man. Some women are so little inconvenienced by it that they do not feel the need of summoning a physician. Others are overwhelmed by acute salpingitis, pelvic abscess, peritonitis even; they must either undergo a capital operation or die. Still another class suffer relatively less from the tubal or uterine complications at first; they are not mortally ill, but they are up one day and down the next, semi-invalids all the time, with scarce a hope of release, unless it be by oöphorectomy, a capital operation, implying loss of the faint remaining hope of children and perhaps a continued invalidism thereafter.

Compared with these major evils the danger of infection of the eyes by the fingers or to the rectum by drips of vaginal secretion is nothing.

Children are doubly endangered by gonorrhea. In the first place, their eyes are in imminent danger of inoculation at the moment of parturition. From such inoculation is said to result more than one-third of congenital blindness.[3]

In the second place, the infant or the young child remains peculiarly susceptible to gonorrheal infection. Its eyes or its genitals may be the portal. Gonorrheal conjunctivitis and urethritis (in the male) present no very peculiar characteristics in the infant. But gonorrheal vulvovaginitis in little girls has a horror all its own. The quite inexplicable readiness of infection, the rebelliousness to treatment, the grave and lifelong complications, make it seem one of the cruelest of known maladies.

The last count in the indictment of gonorrhea is systemic gonorrhea, often spoken of as gonorrheal septicemia or gonorrheal rheumatism. Systemic gonorrhea is very grave, quite rare, and fairly controllable. It is grave in that it causes iritis, endocarditis, a very chronic type of

[1] Moskowitz has reported a tubal pregnancy co-existing with pyosalpinx.

[2] *Am. Jour. of Surgery*, 1906, xx, 236.

[3] Cf. Tivnen, *Jour. A. M. A.*, 1914, lxiii, 1756.

chronic rheumatism, and many other lesions. It is, fortunately, rare; its frequency being estimated at about 1 per cent of cases (Kolle and Hetsch say 0.7 per cent; Ward says 1.2 per cent). Of its control there is no absolute certainty. The disease in most instances progresses slowly to spontaneous cure. The horrors of gonorrheal rheumatism are more talked about than they deserve. Only 20 of the 5,782 gonorrheics in the army were permanently incapacitated by it.

SOCIAL IMPORTANCE OF GONORRHEA

The social importance of gonorrhea depends upon its prevalence, its transmissibility, its grave results in women and children, and the sterility in which it so often results.

Prevalence.—A disease that attacks more than half our young men, a disease that affects thousands of children and hundreds of thousands of women, is important to society by its prevalence alone.

Transmissibility.—A disease that enters the family almost exclusively through illicit sexual contact, a disease that may be transmitted long after the patient thinks himself or herself well, a disease that may be transmitted to the wife from the prostitute via the offending husband, a disease that may be passed from the wife thus innocently infected to the eyes of her infant at birth or to its genitals thereafter, is eminently important to society.

Grave Results.—A disease that incommodes the man and may invalid the woman, a disease that is the cause for most of the major gynecology of today, a disease that unsexes thousands of women, that makes chronic invalids of many, that kills not a few, a disease that in this country causes from one-quarter to one-half of the congenital blindness, that is accountable for about one-third of the blind in our asylums, is a real peril to society.

Sterility.—A disease that causes fully 50 per cent of the involuntarily sterile, or one-child sterile marriages, that destroys the power of procreation in man as well as in woman, is indeed a peril to the race.

SOCIAL REMEDIES

Three types of remedy for gonorrhea are submitted to society:

Individual prevention.

Methods of dealing with prostitutes.

The moral compaign.

To discuss fully the relative merits of the three would require a vol-

ume.[1] Suffice it to say here that an individual preventive, injection of the urethra after a suspicious intercourse (p. 225), though diminishing greatly the danger of infection, does not entirely eliminate it. Segregation and reglementation of prostitutes is neither acceptable nor successful, while the moral campaign, the attempt to bring venereal disease and all sexual matters out into the light of day, seems the only way to get at the root of the evil.

Reglementation is employed with notable failure in France, with mediocre success in Germany. In our country it is impracticable.[2] It fails in theory by not quarantining the males, in practice by not quarantining "illicit" females, the lewd housemaid or shop girl, and the errant widow.

The moral campaign of education to old and young still has its spurs to win. It is very full of promise. The notion that child and bride need education in matters sexual, and that the boy needs clean ideas on these subjects is a new one. But it is hard to see how such education can fail to save many innocents from venereal disease and from moral woes far worse.

[1] The important publications on these subjects are discussed in the various societies of Sanitary and Moral Prophylaxis and of Social Hygiene. Reference may be made to: *Social Hygiene, Trans. Am. Soc. Sanitary and Moral Prophylaxis, Bull. soc. franç. de prophylaxis sanitaire et morale, Mitteil. Deutsch. Gesellschaft z. Bekampf d. Geschlechtskrankh.*

[2] "The Social Evil," Putnam and Co.

CHAPTER XI

THE GONOCOCCUS

That the gonococcus is the cause of gonorrhea is no longer a subject for discussion. Ricord's *"recette pour attraper la chaude-pisse"* is answered by the aphorism of Marcel Seé: *"La plus belle femme du monde ne peut donner que ce qu'elle a."* No person can impart or acquire gonorrhea except by imparting or acquiring the gonococcus.

The gonococcus is a nonmobile diplococcus, occurring within as well as outside of pus and epithelial cells. It stains readily with the familiar anilin dyes. It does not take the Gram. It will not grow on the usual culture media. It produces endogenous toxins. It cannot be inoculated upon animals.

Microscopic Characteristics.—When a drop of gonorrheal pus is properly stained and examined through an immersion lens of one-twelfth aperture, the gonococci seen present the following characteristics:

1. They are diplococci. Each individual of a pair is D-shaped (coffee bean shaped), with the flat (or slightly concave) border opposed to its fellow, so that the couple form an ovoid made up of two separate hemispheres. The length of the pair averages about 1.6μ, and the interspace is about half as wide as either segment.

2. The diplococci are found grouped in pairs, fours, and other multiples of two, showing a tendency to rectangular disposition, in marked contrast to the irregular massing of staphylococci and the linear arrangement of streptococci.

3. The gonococcus, when it occurs in pus, is found both within and outside of the pus and the epithelial cells.[1] The most characteristic groups are met with inside the cells. The extracellular gonococci may be scattered or irregularly grouped, but the intracellular specimens present a greater regularity of arrangement. Without being mathematically distributed, there is still a certain symmetry in the grouping, an absence of jumbling, which the observer soon learns to appreciate at a glance and which our plates attempt to reproduce (Plate IX, Figs. 1, 2).

[1] There is no close clinical relation between the intracellular or the extracellular position of the gonococci and the grade or the stage of the inflammation. Every specimen contains gonococci both inside and outside the cells, and in no definite proportion.

Such are the characteristics of the gonococcus. It is a double D diplococcus occurring intracellularly and in typical groups. But these characteristics are sometimes shared by other bacteria met with in urethral pus. We must look further for a distinguishing feature. This we find in the reaction of the gonococcus to the Gram stain.

Gram Reaction.—*Gonococci do not take "the Gram."* They are "Gram negative." This means that if these cocci are stained first with an anilin dye and then with Lugol reagent (see below) the resultant stain may be washed from them, from the cells, from many other bacteria, but *not from most staphylococci* (the exceptions are discussed on page 194) and other cocci which, under the microscope, may otherwise resemble true gonococci. Hence, when the Gram stain is applied, a thorough washing with alcohol leaves the cells and gonococci colorless, while the pseudogonococci stand out in bold relief, stained darkly by the combined color of the anilin dye and the Gram stain.

In order to make the effect of the Gram stain more apparent, it is customary to restain the cells and gonococci with a contrasting color, in order that the true gonococci may be visible for direct comparison with the false (Plate II, Fig. 2).

Preparation of the Specimen.—From what has been said in the preceding paragraphs, it is clear that recognition of the gonococcus depends upon the proper preparation of the specimen—the proper performance of the Gram test—and while the test is not complicated, it is delicate, and, like so many other laboratory methods that appear entirely simple when one is familiar with them, it does not succeed at the hands of the beginner. Hence every practitioner is by no means competent to perform and interpret the Gram stain; but anyone who can smear a slide and focus a microscope may become competent by practice.

1. The Smear.—A very small drop of the pus to be examined is placed upon a clean glass slide. Upon this another slide is dropped, the two pressed together and slid apart. This leaves each covered with a thin film of pus (the thinner the better). Each is then dried by evaporation at a gentle heat and fixed by rapidly passing it three or four times through the flame of a spirit lamp or a Bunsen burner.

2. The First Stain.—One of the films is now covered with Paltauf's solution.[1]

This is left on for three minutes, the excess washed off with water (no water must be used if the Gram stain is to be employed), the glass dried in the flame, and examined with the oil-immersion lens. If no

[1] Anilin oil, 3 c.c.; absolute alcohol, 7 c.c.; distilled water, 90 c.c. Shake for two minutes. Filter through moistened paper until filtrate is clear. Add two grams of Grübler's powdered gentian violet. Set aside for twenty-four hours. Pipette supernatant fluid as required.

This solution keeps well for six weeks.

bacteria with the morphological characteristics of gonococci are seen after a careful examination, it is a waste of time to employ the Gram. But if what appear to be true gonococci are found, the Gram test is applied to the other slide. The stain is applied for three minutes. as above described, but this time the excess of solution must be shaken from the specimen. *No water or alcohol* may be applied at this juncture. The slide is immediately blotted and flooded with Lugol's solution.

3. The Lugol.—Lugol's solution is made up as follows:

Iodin—1 part.
Potassium iodid—2 parts.
Distilled water—300 parts.

This is applied for precisely two minutes.

4. The Alcohol.—As soon as the slide is removed from the Lugol solution it should be washed with absolute alcohol for precisely thirty seconds.

5. The Contrast Stain.—After using various more or less satisfactory counter-stains I now employ only the following:

Carbolic acid—2 parts.
Saturated aqueous solution of Bismarck brown—98 parts.

If the decolorized smear is covered with this solution for three to five minutes and then rinsed in water, it acquires a light-brown tint, and under the microscope the cells and gonococci appear yellowish and in marked contrast to the deep purple, almost black, pseudogonococci.

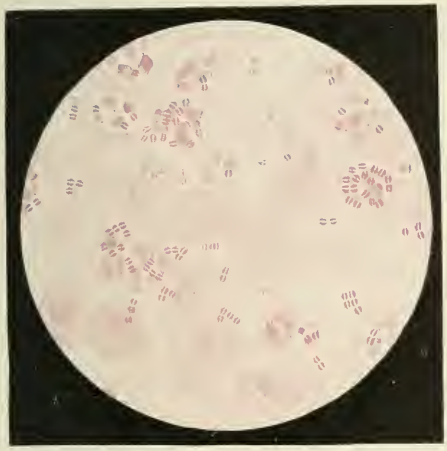
A more prolonged staining with the brown gives the gonococci a deeper color, which is not so readily distinguished from that of the pseudogonococci.

Such is the technic of staining the gonococcus, which may be employed by anyone having an elementary familiarity with medical microscopy, and which may be depended upon to furnish accurate results, if followed accurately. The essentials likely to be overlooked are the employment of *Grübler's* violet, *precise* staining, by the watch, employment of *absolute* alcohol, and exclusion of *all* water until after counter-staining.

GONOCOCCUS CULTURE

The gonococcus can be made to grow only on special media and under special conditions.

The medium must contain human blood serum and be slightly alkaline. This serum may be obtained from an aseptic effusion into the peritoneum, the pleura, or the tunica vaginalis. (Experts can obtain slight growth of gonococci upon ordinary culture media.)



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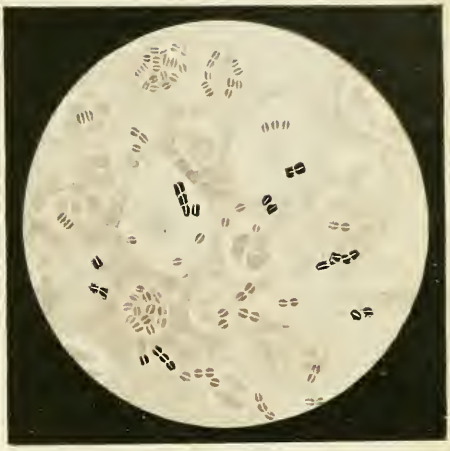

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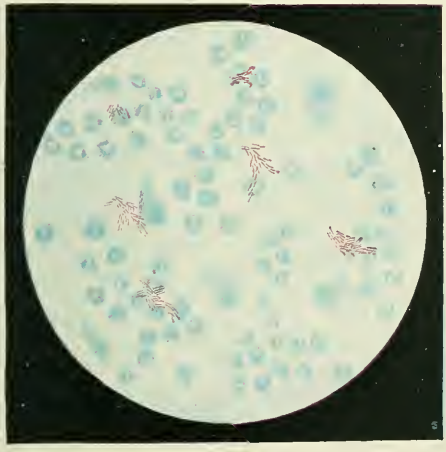

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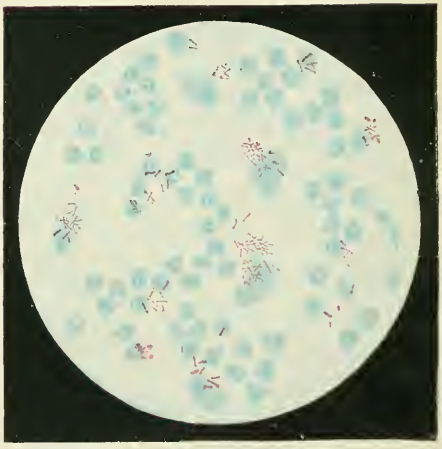

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MICROPHOTOGRAPHS OF GONOCOCCI AND TUBERCLE BACILLI.

FIG. 1.—Gonorrheal pus. First stain: gentian-violet solution

FIG. 2.—Gonorrheal pus. Bismarck-brown. Cells and gonococci take the brown stain, while the pseudogonococci remain black.

FIG. 3.—Tubercle bacilli in urine.

FIG. 4.—Smegma bacilli in urine.

Heiman [1] employs the following culture medium:

Sterilized liquid chest serum, 1 part.

Agar, 2 per cent + peptone, 2 per cent + salt, 0.5 per cent + glucose, 2 per cent, 2 parts.

He sterilizes the liquid by heating it to 65° C. for one hour for six days, then he leaves it three days at the room temperature, then resterilizes for three days more.

The incubator must be kept at a temperature between 30° and 39° C. The ideal temperature is 36° to 37° C.

The growth of gonococci is relatively slow. They are aërobic and facultative anaërobic. The colonies remain rounded and usually do not run together. They are grayish in color and slightly translucent. Growth ceases in about forty-eight hours; sooner if the surface of the agar dries. Examination should therefore be made at the end of the second day. To continue the growth it must be shifted to a new medium every three or four days or oftener.

The vitality of the gonococcus is slight whether in smears or in culture. Desiccation kills it in a few hours. But Heiman has cultivated the gonococcus from a thick drop of pus twenty-nine days old. It is killed by a temperature of 45° C., and ceases to grow below 30° C. Any weak antiseptic rapidly destroys the gonococcus *in vitro*. Cultures from urine must therefore be made without delay and before the urine cools.

DIAGNOSIS OF THE GONOCOCCUS

The gonococcus is usually distinguished from staphylococci and other Gram-positive cocci by the Gram stain. Errors in diagnosis by the Gram stain (apart from those due to ignorance and carelessness) have three sources, viz.:

1. There are other Gram-negative cocci from which the gonococcus can only be distinguished by culture.[2] Such are the micrococcus catarrhalis, the diplococcus intracellularis, and certain chromogenic cocci.

Happily none of these organisms, except the micrococcus catarrhalis, have been identified in the genito-urinary tract. None of them, except the m. catarrhalis, is believed to cause urethritis. The urethritis caused by m. catarrhalis is probably insignificant, and not to be clinically mistaken for acute gonorrhea. I have encountered it but once in several hundred cases.

[1] *Med. Record*, 1895, XLVII, 746; *Ibid.*, 1896, L, 887; *Ibid.*, 1898, LIII, 80.

[2] *Cf.* Zupink, *Berl. klin. Wochenschr.*, 1906, No. 52; Wollstein, *Jour. of Exper. Med.*, 1907, September 21st; Elser and Huntoon, *Jour. of Med. Research*, 1909, XX, No. 4, p. 369.

2. Apart from m. catarrhalis, it must be emphasized that in a small percentage of cases the normal urethra (and in a somewhat larger percentage the normal vagina) contains Gram-negative cocci which can usually be differentiated from the gonococcus by their form, size, and extracellular position. These organisms fail to grow on the ordinary culture media.

3. The most frequent source of error is the fact that the common *staphylococci may be Gram-negative as well as Gram-positive.* As Crabtree has suggested, this variability is doubtless due to the presence or absence of albumin.

But these confusing factors, that render the diagnosis by Gram alone quite valueless, apply almost exclusively to chronic urethritis. For clinical laboratory diagnosis of acute genital gonorrhea it is only necessary to identify a Gram-negative, intracellular diplococcus.

The gonococcus in the conjunctiva and in joint exudates is equally unmistakable.

Rectal, buccal, and nasal gonorrhea require diagnosis by culture.

The cultural characteristics of the gonococcus have been described. An important feature in the diagnosis is that the gonococcus ferments glucose (and perhaps maltose, but not other sugars).

The micrococcus catarrhalis grows more readily than the gonococcus on the usual media. On serum-agar it makes two kinds of colonies, the one thick and crumbling like mortar does not resemble the gonococcus, the other is quite similar to the gonococcus, except that the colony is smaller. But the distinguishing feature of the micrococcus catarrhalis is its inability to ferment glucose.

The other members of this group grow more readily on the familiar media. Thus the diplococcus intracellularis grows on nutrient or glycerin-agar and on Loeffler's blood serum agar.

Concerning serum reactions Elser and Huntoon state that:

> When properly controlled, agglutination tests serve to differentiate the various groups from each other, providing the strains tested are sufficiently agglutinable. Diagnostic difficulties may arise in connection with certain gonococcus strains. These are unusually sensitive to the action of normal and of group agglutinins and may yield higher values in the presence of a meningococcus immune serum than moderately agglutinable meningococcus strains.
>
> Absorption tests served to differentiate the various groups of Gram-negative cocci from each other and to establish the identity of the agglutinable and inagglutinable meningococcus strains.

COMPLEMENT FIXATION TEST

The gonococcus complement fixation test of Schwartz and McNeil[1] is peculiar only in that the antigen employed is made from mixed

[1] *Am. Jour. Med. Sciences,* May, 1911, December and September, 1912; see also

strains of gonococci. The original antigen was made from eleven different strains and as various ones of these died off, or were lost, they have been replaced by others.

The reaction becomes positive rarely before the fourth week, but usually in the sixth to the eighth week. It never becomes positive in cases that are so successfully repressed, or aborted, as never to have any considerable infection.

The reaction usually remains positive as long as there is any active gonorrheal infection in the patient's body. Thus a persistent joint lesion or tubal infection (in the female) may keep up a positive reaction after the urethral infection has been cured. Two exceptions are to be noted in the time of disappearance of the positive reaction as follows:

1. The urethral lesion may become so slight and superficial that the complement fixation test becomes negative before the last gonococcus has disappeared. I have never known this to occur excepting in cases of mild chronic anterior urethritis that reacted brilliantly to the passage of a sound in the form of an acute obviously gonorrheal urethritis. This check can, therefore, apparently be relied upon and the combination of a negative gonococcus fixation test with absence of reaction to the passage of a sound is an almost certain guarantee of cure.

2. The fixation test usually remains positive two to six weeks after all clinical evidence of infection has disappeared from the urethra and its glands. But it may persist for months. Such a persistent positive reaction is extremely unusual, but I have seen three men with a positive gonococcus reaction a year after the last trace of gonorrhea had disappeared from the urethra; each of them was repeatedly tested by culture for gonococcus with negative results. Two of them married and did not infect their wives, though the reaction of one of these was still weakly positive six months after matrimony. I do not know what focus of infection kept up the reaction in these cases.

The reaction presents two interesting medico-legal features:

1. If within three weeks of the time when a fresh urethral discharge appeared the patient's blood is found positive the discharge is probably a relapse from a previous infection. If negative it is doubtless a new infection. The nearer the test is made to the beginning of the infection, the more accurate it is likely to be.

2. The reaction of a person who has not recently had a gonorrhea cannot be made positive by the injection of gonococcus vaccines; but if the complement fixation test has been positive within the preced-

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confirmatory articles by Swinburne, Keyes and Schmidt, *Am. Jour. Med. Sciences*, Arch. of Diag., July, 1911, *Am. Jour. Med. Sciences*, January, 1912; *Trans. Am. Urol. Assn.*, 1911.

ing six months and vaccines are given it is readily made positive again.

Diagnostic Value.—The accuracy of the complement fixation test, like that of the gonococcus culture, varies in accordance with the skill and experience of the operator; but, exception made for infection confined to the anterior urethra, technical errors are much less likely to interfere with the validity of the complement fixation test than with gonococcus culture. Positive culture, on the other hand, is more certain evidence that an infectious lesion persists in the urethra than is a positive complement fixation test. Nevertheless the practitioner will be wise to rely more upon the complement fixation test than upon anything else for the diagnosis of the presence of gonorrhea.

GONOCOCCUS VACCINES

Christmas [1] and Wassermann [2] have shown that gonococci produce only an endotoxin derived from dead and disintegrated microörganisms. Thus the toxin may be measured in units of bacteria. Accordingly, one speaks of a solution containing 20,000,000 or 1,000,000,000 dead gonococci, meaning a solution containing the toxins of that number of dead bacteria.

The vaccine is sold in phials containing 20,000,000 to 500,000,000 dead gonococci to the c.c.

Autogenous and Stock Vaccines.—Teague and Torrey [3] have shown that the serum of an animal immunized to one strain of gonococcus does not cause fixation of complement when tested against an antigen obtained from another strain. Following up this line of investigation Torrey was able to differentiate eleven strains of gonococci in New York City, and most of the stock vaccines now sold are from a mixture of these eleven strains.

It is difficult to compare the efficacy of autogenous and stock vaccines on a scientific basis. Autogenous vaccines have the advantage of giving a definite product distinctly and certainly applicable to a given case, but they have the disadvantage of requiring from two to four days' preparation. We cannot get them at the time when we most need them.

Local pain from the injection is slight, local inflammatory reaction rare. General toxic or febrile reactions are not unusual if the vaccine treatment is begun at a high dose or pushed rapidly. But the discomfort

[1] *Am. Institut Pasteur*, 1900, XLV, 331.
[2] *Berl. klin. Wochenschr.*, 1897, No. 32.
[3] *Jour. of Med. Research*, December, 1907.

of a reaction accompanied by a temperature of 103° F. and lasting not more than twelve hours is the most that may be expected.

Dosage.—The vaccines have been employed at an average dose of 10,000,000 to 20,000,000, increased to a maximum of 50,000,000. Such doses are too small. One should begin at 40,000,000 or, in acute cases, 60,000,000 and increase by 20,000,000 or more at each dose (unless the symptoms are controlled, or the reaction is marked) until a dose of 200,000,000 is reached. Only in exceptional cases is it necessary to go higher than this.

The injections are given into the muscle. *They should not be repeated oftener than every other day.*

Results.[1]—Gonococcic vaccines have been employed in various classes of cases, viz.:

In localized gonorrhea—
- Acute urethritis.
- Chronic urethritis.
- Vulvovaginitis.

In complications of local gonorrhea—
- Epididymitis.

In systemic gonorrhea—
- Acute arthritis or iritis.
- Chronic arthritis.
- Sepsis.

Localized Gonorrhea.—So long as gonorrhea remains localized upon the genital and urinary mucous membranes it excites no systemic reaction, and is seemingly uninfluenced by the injection of vaccines. Individual instances of the cessation of an intractable gonorrhea under the administration of vaccines prove nothing. Chronic gonorrhea is, as a rule, quite uninfluenced by the vaccine treatment. I have not even noted an increase in the gonococci in the urethral discharge, though certain Continental authorities rely upon the vaccine to excite a discharge if gonococci are present (focal reaction).

Genital Complications.—It is my practice, whenever a gonorrheic develops fever or any symptoms suggestive of acute epididymal, prostatic, or peri-urethral complications, to administer 50,000,000 gonococci and to follow this two days later by the same dose if all is well, by double the dose if the symptoms continue.

One may thus perhaps abort the threatened complications.

When the metastatic (e. g., epididymal) focus is established, however, I have seen no positive good result from vaccine.

[1] Cole and Meakins, *Bull. Johns Hopkins University*, 1901; Irons, *Jour. of Infect. Dis.*, June-July, 1908; Ballenger, *Jour. Am. Med. Assoc.*, May 30, 1908, p. 1784; Van Riempst, *Polyclinic Med. Jour.*, 1909.

Systemic Gonorrhea.—The vaccine treatment finds its most rational application in the treatment of systemic gonorrhea. Thus many authorities rely upon frequent injections of from 50,000,000 to 500,000,000 killed gonococci. I at one time believed in this treatment; but a large experience at Bellevue Hospital has left me utterly skeptical.

In the second place, the painful lesion of many so-called cases of chronic gonorrheal arthritis is an organic one, an exostosis or a change in ligament or synovial membrane due to a gonococcal inflammation that has passed, and preëminently unsuited to any vaccine treatment.

Gonorrheal septicemia sometimes reacts brilliantly, sometimes not at all. Autogenous vaccines should be used if possible.

ANTIGONOCOCCUS SERUM

The antigonococcus serum employed in this country is that of Rogers and Torrey.[1] The serum is polyvalent (like the vaccine). It is derived from rams, since their serum seems much less toxic than that of goats or rabbits.

Technic.—Two c.c. of the serum are injected every day or every second or third day.

Complications.—With ram serum the only reaction that one may anticipate is a varying amount of local swelling, redness, heat and soreness around the point of injection. This does not occur by any means in every individual case, and is not caused by any antibody in the serum, but is due to the local toxic action of the serum itself. As the same serum has been found to cause this reaction in one individual but not in another, it is partly referable to the idiosyncrasy of the patient (Rogers).

Results.[2]—The results reported from the use of the serum are quite similar to those reported from the vaccine. I have not experimented with the serum.

Rogers claims good results in 85 per cent of early joint cases, and some good in late cases if treatment is continued for a month or more. Herbst, using three times the usual dose, achieved very satisfactory results in all chronic joint cases, but nothing in epididymitis and acute arthritis. Swinburne warmly advocates the serum at the onset of epididymitis, stating that in 27 cases so treated the pain was relieved in forty-eight hours.

[1] *Jour. Am. Med. Assoc.*, January 27, 1906, and September 14, 1907.

[2] Rogers and Torrey, *loc. cit.;* Herbst, *Jour. Am. Med. Assoc.*, May 23, 1908. Swinburne, *Jour. Am. Med. Assoc.*, January 26, 1907, and *Med. Record*, November 14, 1908.

IMMUNITY

The gonococcus confers a relative immunity to the person who harbors it. He can usually not be reinfected; e.g., by a woman upon whom he has conferred the disease. Moreover, relapses of a given gonorrhea are almost invariably less severe than the initial outbreak.

But the immunity that persists after a cured gonorrhea is of the slightest. Subsequent attacks are usually milder than the initial one; but they may be quite as prolonged, quite as complicated.

CHAPTER XII

GONORRHEA: THE EXTRAGENITAL TYPES OF INOCULATION; THE SYSTEMIC MANIFESTATIONS

The gonococcus is specific to the human race. It is impossible to give gonorrhea to any animal.

The gonococcus may be inoculated readily in the eye, in the urethra of either sex, and in the female genital passages. The rectum is less vulnerable than the genitals. The mouth and nose are all but immune. The unbroken skin cannot be inoculated, and all squamous epithelium offers a marked resistance. Thus the urinary bladder, the preputial cavity of the male and the vagina of the female suffer rarely and, as a rule, mildly from gonorrhea, except in so far as they are involved in the contiguous inflammation of the urethra, the cervix, or the vulva.

That children are much more vulnerable to gonorrhea than adults is evidenced by the readiness with which little girls acquire vulvovaginitis, the frequency of gonorrheal conjunctivitis in children, and the fact that nasal and buccal gonorrhea occur almost, if not quite, exclusively in children.

EXTENSION OF THE DISEASE

Gonorrhea of the eye and rectum remain localized. In the genitals the disease extends by continuity as far as the vesical trigone, and throughout the genitalia of both man and woman.

The gonococcus penetrates the epithelium of the inflamed surface and excites exudation and subsequently sclerosis in the subjacent connective tissue; but it shows no great tendency to cause lesions to any depth except when shut in by inflammatory occlusion of the orifice of a gland. Under such circumstances it may cause abscess, invade the veins (thrombosis), and be carried to distant parts of the body, there to set up metastatic gonorrheal foci.

Clinically this local suppuration and general intoxication occur almost exclusively in the genitals; i.e., the urethra, prostate, vesicle, and epididymis of the male, the glands of the urethra, vagina and cervix, and the fallopian tubes in the female.

By means of the blood stream gonococci may be carried to almost any organ. The favored locations for systemic gonorrhea are the joints and the iris. Less frequently it attacks the bursae, the tendon sheaths, the

pleura, the meninges, the periosteum, the parotid gland, the veins, the endocardium, the pericardium, the muscles.

Lymphatic absorption is uncommon and gonorrheal lymphangitis and lymphadenitis rare.

Absorption of gonorrheal toxins may affect the nervous system or the skin.

The peritoneum is not rarely involved in gonorrheal salpingitis, but gonorrheal peritonitis is extremely rare in the male. The kidneys are probably reached by gonococci from the blood stream, though direct invasion from an infected bladder is not impossible.

ANORECTAL GONORRHEA

The anus is relatively immune to the gonococcus. Every acute vulvar gonorrhea pours pus over it, and yet, even in infants, it is not often inflamed. Jullien [1] has collected from the statistics of Howard, Schultz, and Baer, 1,037 cases of genital gonorrhea in women with 157 inoculations of the anus. Eichorn [2] noted anal infection in 72 out of 235 cases.

Etiology.—Sodomy is the accepted cause for anal gonorrhea in men; but in women the infection is more often due either to direct inoculation by pus from the vulva or by indirect inoculation from the douche tube or the finger.

Pathology.—The lesions are both deep and chronic. The epithelium of the rectum is eroded, infiltrated, and in places ulcerated for several inches up from the anus.

Fissure and condyloma are common; the anus itself is infiltrated. Ischiorectal abscess and phlebitis of the hemorrhoidal veins have been noted as rare complications. Whether or not rectal gonorrhea is often a cause of stricture is not determined. The stricture is usually observed so late that its cause is not clear.

Symptoms.—The symptoms are so slight that the condition is often overlooked. At the onset there is at most itching and burning. Later there are to all intents and purposes no subjective symptoms.

Physical Signs.—The lesion is rather rectal than anal. The anal orifice may be swollen; it is almost always fissured—"at six o'clock," as the French say. A single moist, pointed, soft condyloma usually overhangs the fissure. There is often no external discharge, but a drop of pus may readily be expressed by pressure from the rectum. Proctoscopy reveals tumefaction, erosion, and ulceration of the rectum.

[1] *Le Blennorrhagie (formes rares et peu connues)*, Paris, 1906. Also Brunswick-le Bihan, *Bull. de l'Acad. de Méd.*, Paris, 1907, LXXI, p. 497.

[2] *Dermatolog. Zeitschr.*, 1909, XVI, No. 7.

Duration.—Rectal gonorrhea is extremely chronic. Jullien treated four successive cases 116, 169, and 174 days before achieving a cure.

Diagnosis.—The gonococcus may be identified in the pus. If the condition of the genitals leaves any doubt as to the nature of the inflammation, the diagnosis should be verified by culture.

Treatment.—The rectum may be irrigated daily with potassium permanganate (1:200 to 1:25) or with protargol (2 per cent to 10 per cent). Erosions and ulcers may be touched every second or third day with a nitrate of silver pencil.

BUCCAL AND NASAL GONORRHEA

That gonorrheal inflammation of the mouth and nose may occur we cannot doubt. That it does occur in infants may be considered proven. But its existence in the adult is at best uncertain.

The existence of buccal gonorrhea in infants was proven by Ahlfeld.[1] Kimball [2] has reported 8 cases of systemic gonorrhea in infants, one or more of whom were doubtless infected from the mouth. De Stella [3] has apparently proven the existence of infantile nasal gonorrhea.

In adults, however, we hear only of sporadic cases. The cases collected by Jullien fall under two heads, those in which urethral gonorrhea has been attributed to coitus *ab ore* (cases of Howard and Honnorat) and those in which stomatitis (cases of Cutler, Petit, Columbrine, Juergens, and four of Menard) or rhinitis (cases of Duncan (1784), Forcade, Edwards) are alleged to be gonorrheal.

The evidence against nasal gonorrhea in the adult is summed up in the experiments of Diday and Bormiere, who strove in vain to inoculate the nasal mucosa with gonorrheal pus. The clinical cases in favor are rare, ancient, and unconvincing.

Buccal gonorrhea is fortified by more modern instances. But the alleged gonococcus found may perfectly well have been the meningococcus or micrococccus catarrhalis, and the "intense" stomatitis is precisely what one would not expect.

A typical report has recently been made by Juergens.[4] The stomatitis was intense, the gums ulcerated, the breath fetid. Bacteriologic examination revealed the "gonococcus" and the bacteria of Vincent's angina.

In this instance the stomatitis was doubtless a Vincent's angina, the

[1] *Berl. klin. Wochenschr.*, October 19, 1896.
[2] *Med. Record*, 1903, LXIV, 761.
[3] *Deutsche med. Zeitschr.*, 1899, No. 1.
[4] *Berl. klin. Wochenschr.*, June 13, 1904.

"gonococcus" a micrococcus catarrhalis. Until such cases are tested by culture we cannot form a final decision.

Clinical Picture.—In infants the inflammation appears to be a severe one and always confined, curiously enough, either to nose or mouth. In some instances nasal gonorrhea has accompanied ophthalmia neonatorum and has been attributed to infection through the lacrimal duct.

The duration of the inflammation is a few weeks, as a rule.

Treatment.—Antiseptic mouth wash and nasal spray effect a speedy cure. Argyrol in 20 per cent solution is the best wash, but frightfully dirty.

SYSTEMIC GONORRHEA

The gonococcus invades the system through the blood stream. Its toxins may be absorbed by the same route. Though no one has disproven the participation of gonococcus toxins in the causation of the local lesions of systemic gonorrhea, the gonococcus has so frequently been found in the pus of joints and on the vegetations of heart valves and even in the blood[1] that such lesions are attributed to the bacterium itself, leaving certain rare and manifestly toxic phenomena attributed to the toxin.

Toxic Lesions.—Skin lesions, neuroses.

Bacterial Lesions.—Arthritis, osteo-arthritis.
Endocarditis, pericarditis.
Bursitis, tenosynovitis.
Periostitis, osteitis.
Myositis, abscess.
Iritis, systemic conjunctivitis.
Phlebitis, thrombosis.
Pleurisy, pneumonia, parotitis.
Neuritis, meningitis (?).

Erythema and Neurosis.—Erythema, urticaria,[2] pruritus,[3] and various neuroses may occur during gonorrhea and may be relieved by cure of the gonorrhea.

The feeling of disgust, even amounting to neurasthenia, excited by "venereal" disease is, of course, purely psychic. Sexual neurasthenia is not peculiar to gonorrhea.

[1] Irons, *Arch. Int. Med.*, Dec., 1909.
[2] Orlipski, *Münch. med. Wochenschr.*, October 7, 1902.
[3] Domenici, *Gaz. degli osp.*, March 1, 1903.

GONORRHEAL ARTHRITIS

Gonorrheal arthritis or gonorrheal rheumatism, as it is commonly called, is the commonest type of metastatic gonorrhea.

Occurrence.—Gonorrheal rheumatism is said to occur in about 1 per cent of persons afflicted with urethral gonorrhea. Children are particularly prone to it and may develop it from slight local lesions. Thus Kimball [1] found 10 cases of gonorrheal arthritis among 70 children. Women are much less often affected than men, doubtless because they lack seminal vesicles. Northrup [2] reports 230 cases in the male to 22 in the female. It has been noted by Fournier as early as the fifth day after the onset of gonorrhea, but is commonest between the third and the fifth week. It may occur at any time while the patient harbors gonococci.

Certain cases show a marked tendency to relapse of joint symptoms with each new attack of gonorrhea. Fournier and Keyes, Sr., have each recorded an instance of four such relapses in a single patient, and Brandes has seen six.

Etiology.—Retention of pus in the seminal vesicles is believed to be the usual cause of gonorrheal rheumatism. We do not yet know how broad this rule may be.

Distribution.—The lesions are often polyarticular. Among Northrup's cases 76 per cent showed involvement of three or more joints. Moreover, synovitis, bursitis, and the other lesions of systemic gonorrhea are often associated with joint lesions.

The knee is the joint most frequently affected (two-thirds of Fournier's 120 cases, one-third of Finger's [3] 375, seven-eighths of Boneman's 278 cases).

Northrup's statistics show gonorrhea of the knee in 91 cases, of the ankle in 57, of the foot in 40, of the wrist in 27, of the heel and toes in 21, of the elbow in 18, of the hip and shoulder 16 each, of the hand in 11.

The association of gonorrhea with spondylitis has been suggested by Bouchard [4] and Chute.[5]

Pathology.—Gonorrheal arthritis is but a single expression of a general infection. Like other forms of septic arthritis, it depends upon bacterial localization, either in the joint itself or in the articular extremity of the bone. Hence the two distinct types of the disease, gonorrheal arthritis and gonorrheal osteo-arthritis.

[1] *Medical Record*, 1903, LXIV, 761.
[2] *Presbyterian Hospital Report* (New York), 1896, vol. i, p. 53.
[3] *Archiv f. Derm. u. Syph.*, 1894, XXVIII, 2, 296.
[4] *Zeitschr. f. klin. Med.*, 1907, LXII. [5] *Boston Med. and Surg. Jour.*, 1904.

Clinical Types.—The onset may be acute or subacute. If acute, the inflammation begins like an attack of acute articular rheumatism, with pain, redness, swelling, tenderness, and disability. But there are no sweats; the brilliant redness and exquisite sensitiveness of acute articular rheumatism are not seen, and fever is relatively slight.

A subacute onset varies in intensity from a mere ache with local tenderness to a moderately severe pain with some swelling and considerable disability.

The duration of the inflammation is characteristically prolonged, although exceptionally an intense attack is brief. The mildest lesion may hang on for weeks and months.

The *severity* of the inflammation is moderate as compared to other types of septic arthritis. There is more or less thickening of the soft tissues, and usually no great exudation within the joint. Yet exceptionally the joint may be filled with a purulent exudate and be the cause of intense sepsis.

Complications.—The complications due to direct extension from the joint are bursitis, tenosynovitis, and infiltrations of the surrounding tissues. Abscess outside the joint, as in the case reported by Ware,[1] is even rarer than suppurative arthritis. Implication of the bone is, as stated above, primary and not secondary.

The results of gonorrheal arthritis depend upon the treatment and the nature of the lesion. Osteo-arthritis may even result in total destruction of the joint with bony ankylosis. The worst that simple arthritis can do is to cause fibrous ankylosis. The most discouraging features of the prognosis are the marked tendency to chronicity, and the tendency to relapse after apparent cure.

Diagnosis.—The diagnosis of acute gonorrheal rheumatism occurring during the course of gonorrhea is not difficult. Under these circumstances marked swelling in a joint, with slight constitutional disturbances, is very suspicious. A positive complement fixation test for gonococcus confirms the diagnosis. The para-articular involvement gives the swelling a characteristic fusiform shape.

Acute gonorrheal rheumatism occurring in the absence of gonococcic urethral lesion (as in the children reported by Kimball) may be diagnosed by the complement fixation test, or by identification of the gonococcus in the fluid aspirated from the joint. But this fluid, whether serous, serofibrous, or purulent, is usually quite sterile.

Chronic gonorrheal arthritis must be differentiated by the complement fixation test from other forms of septic arthritis. Nathan[2] insists that though gonorrheal arthritis may be recurrent, it is never really chronic, and that the cases called chronic "are those in which

[1] *N. Y. Med. Jour.*, January 13, 1906.

[2] *Ibid.*, Mar. 16, 1907.

the initial acute inflammation has left behind bands of adhesion or other structural change in the synovial membrane in arthritis, and bone outgrowths or ankylosis in osteo-arthritis. These changes, unless treated mechanically or by operation, are permanent."

Prophylaxis.—Among the gonorrheal patients I have treated from the onset of their disease not one has developed systemic gonorrhea. This is in a measure the dispensation of a kind Providence, but it is primarily a result of the proper treatment of the disease in its early stages. The local treatment of acute gonorrhea almost certainly prevents systemic gonorrhea.

The injection of vaccines at the first appearance of the fever in the course of a gonorrhea also has a prophylactic effect.

Curative Treatment.—Inasmuch as acute gonorrheal arthritis is but one lesion in a general systemic infection, the patient should be considered septic and the possibility of further systemic gonorrhea should be recognized. He should be put to bed and *the urethral source of infection vigorously attacked.* Inasmuch as the seminal vesicles are believed to be the usual source of infection, these glands should be massaged. The precise status of vesiculotomy in the treatment of gonorrheal rheumatism is not yet precisely defined. It unquestionably cures some cases and fails to cure others (p. 245).

The joint should be immobilized and Bier hyperemia employed throughout the acute stage. A light plaster-of-Paris bandage or splint affords the best immobilization and does not interfere with the Bier treatment. The patient should not be permitted to use the affected limb before the acute inflammation has subsided, however mild this be.

The one way to prevent permanent changes in and about the joint is by careful local treatment during the acute stages. The beneficial effect of the Bier treatment cannot be doubted.[1]

The specific vaccines and sera afford little relief (p. 114). One or the other should always be employed. "Hot-air" baking[2] has much the same effect as the Bier treatment.

If the tension within the joint is not promptly relieved by immobilization and passive hyperemia, the fluid should be aspirated. The presence of pus in the joint is not of itself an indication for more vigorous surgical measures, for it is likely to be spontaneously absorbed. But if the pus persists, arthrotomy should be performed and the joint irrigated with 1 : 2,000 nitrate of silver solution.

As the acute symptoms subside the diagnosis should be accurately made between arthritis and osteo-arthritis. The former requires that the immobilization be prolonged and passive motion begun cautiously,

[1] Cf. Bier, "Hyperæmia als Heilsmittel." Baetzner, *Deutsche Zeitschr. f. Chir.*, 1907. Von Tiling, *Jour. Am. Med. Assn.*, April 29, 1905, p. 135.

[2] Wagner, *Med. Klin.*, IV, June 21, 1906.

the latter that passive motion should be begun early, before the splint is left off, and that massage, passive motion, and splints be used until function is entirely restored.

Exostosis of the Os Calcis.[1]—Though first described as recently as 1906 (by Baer), this condition is so common and so painful as to merit special mention. It begins as a myositis or periostitis at the attachment of the flexor brevis digitorum to the tubercle of the os calcis. With the subsidence of the acute inflammation an exostosis forms, pressure upon which (in walking) is exquisitely painful. The *diagnosis* is made by radiography. The *treatment* is operation. The exostosis must be chiselled or scraped away after exposure through an incision along the inner side of the heel.

GONORRHEAL ENDOCARDITIS

Systemic gonorrhea produces heart lesions in from 10 per cent to 20 per cent of cases. Thus Nolan recognized heart lesions of probable gonorrheal origin in 16 out of 115 cases of gonorrheal arthritis and Sears [2] in 25 out of 167.

Sears has analyzed 68 cases of gonorrheal endocarditis, of which 61 were in men, 7 in women. The heart lesion was associated with arthritis in 56 cases, in 48 of which the lesions involved three or more joints, while in 10 there were no joint lesions. The heart was involved during the first gonorrhea certainly in 31 cases, probably in 9 more. In one instance the heart is alleged to have been involved during the second day of a gonorrhea. As a rule the lesion was first noted during the fifth or sixth week.

Pathology.—The lesions are usually confined to the heart valves. Exceptionally there is pericarditis or myocarditis. "In 38 cases the mitral valve alone was involved, in 12 the aortic, and in 2 the pulmonic. The mitral and aortic were both involved in 8, the mitral and tricuspid in 1, the aortic and pulmonic in 1" (Sears).

The pathologic changes [3] in the valves usually consist in small friable vegetations made up of plasma cells, leukocytes, and red blood-corpuscles in a loose framework. Sometimes the valve is exulcerated, even perforated. Gonococci may usually be cultivated postmortem from the lesions and sometimes antemortem from the blood.

Clinical Types.—Two clinical types are recognized, viz., simple gon-

[1] Winthrop, *Jour. A. M. A.*, 1909, LIII, 715.

[2] *Boston City Hosp. Reports*, 1898, IX, 201.

[3] Cf. Rosenthal, *Berl. klin. Wochenschr.*, November 26, 1900; Thayer and Lazaer, *Jour. of Exper. Med.*, 1899, IV; and Thayer, *Am. Jour. of the Med. Sci.*, November, 1905.

orrheal endocarditis and malignant gonorrheal endocarditis. Neither type shows any clinical peculiarity to stamp it as gonorrheal. The former is mild and insidious in onset, perhaps entirely latent, so that the resultant murmur, perhaps recognized years after, may be the only symptom. The malignant type, on the other hand, usually begins abruptly with chill, and progresses with intense septic fever. Yet the types are neither fixed nor exclusive; a case may begin mildly and become malignant later, or, beginning in the most acute fashion, it may rapidly subside.

Diagnosis.—A patient who develops a heart murmur or malignant endocarditis while suffering from gonorrheal rheumatism may be put down as a case of gonorrheal endocarditis. This diagnosis is confirmed by the complement fixation test or the cultivation of gonococci from the blood.[1]

Prognosis.—Sears believes that a mitral lesion offers a better prognosis than any other, since of the 43 cases in his series that recovered, 33 gave signs of lesions in that valve.

Cardiac symptoms, if present, usually persist a month to six weeks, septic symptoms two to four weeks. The damage to the valve is usually permanent and the murmur persists. Fatal cases usually terminate in two or three weeks, but the patient may survive several months.

Treatment.—The treatment is that of endocarditis plus the antigonococcus vaccine or serum.

[1] Lofaro, *Il Policlinico,* Feb., 1911, No. 2, p. 49.

CHAPTER XIII

OCULAR GONORRHEA

It is convenient to group in one chapter infectious gonorrheal conjunctivitis and the ocular lesions of systemic gonorrhea, though the relations between them are anatomic and biologic, but not clinical. The gonococcus does not invade the system from the conjunctiva.

INFECTIOUS GONORRHEAL CONJUNCTIVITIS

The frequency of gonorrheal conjunctivitis in infants and its rarity in adults has been mentioned in Chapter X.

The infection is due to contact with gonorrheal pus, derived from the mother's genitalia during parturition or, in after life, from contact with dirty fingers.

Symptoms.—The incubation period is believed to be from twelve to forty-eight hours in adults. In infants the inflammation first shows itself on the third or fourth day. In adults one eye is usually spared if properly protected, but in infants the lesion is commonly bilateral.

The onset is hyperacute, as a rule. The subjective symptoms of burning and itching are promptly exchanged for intense and constant pain. The lids are intensely red and swollen. They must be forced apart to obtain a view of the globe. The ocular conjunctiva is intensely inflamed and so swollen that it overhangs the cornea, which thus seems sunk into the depths of the globe. The subconjunctival edema soon interferes with the circulation of the cornea, which is usually more or less necrosed. This corneal necrosis or ulceration, if situated near the periphery, may be concealed during the acute attack by the overhanging conjunctiva.

The pain completely exhausts the patient, but there is no fever.

The corneal destruction results in opacities which, if central, destroy the vision. Perforation of the cornea results in prolapse and involvement of the iris. Iritic adhesions may occur without perforation.

Prognosis.—The infection, though rarer, is usually much more severe in adults than in infants. The sight of an adult is rarely saved, that of an infant often is.

The duration of the acute disease is from two to six weeks, a mild

conjunctivitis persisting as long again. It may leave a pseudotrachoma. Corneal destruction is often far less than would be expected from the intensity of the inflammation. Glaucoma may supervene in a badly damaged eye.

If an eye is destroyed by gonorrheal or other purulent inflammation the danger of sympathetic inflammation of the opposite eye is very slight, if it ever occurs (Knapp). It is not, therefore, proper to remove the stump for fear of this dreaded complication, a fact well to bear in mind, because a shriveled stump of an eye furnishes a base of support for an artificial eye.

Diagnosis.—Almost every hyperacute purulent conjunctivitis is gonorrheal and almost every gonorrheal conjunctivitis is purulent. The microscope determines the diagnosis. There is a pseudogonorrheal conjunctivitis neonatorum of relatively mild type, not uncommon in institutions. This accounts for a large percentage of cases.

Prophylaxis.—An antiseptic should be dropped into the eyes of every child at birth. There are no exceptions to this rule of practice. The antiseptic usually instilled is 2 per cent silver nitrate, as advised by Credé.[1]

The adult exercises prophylaxis by keeping his fingers clean and out of his eyes. I have never known a case of gonorrheal conjunctivitis in my private practice.

Treatment.—The sick-room should be kept dark, the patient in bed.

Local treatment must be properly instituted. Delay may jeopardize the eye. The essentials of treatment are three:

1. Antiphlogosis: Cold.
2. Cleanliness: Irrigation.
3. Antiseptics: Bactericides.

The greatest possible care is necessary in handling the tender swollen eye. No pressure is allowable.

All dressings should be the lightest possible, and tenderly placed by a delicate hand. The swollen upper lid is already weight enough. The utmost care should be used in protecting the sound eye from contagion. Buller's shield, a watch glass set into perforated squares of rubber plaster, is not so good as Knapp's suggestion, a mica spectacle plate (to be obtained from any optician) fastened on with rubber plaster strips. This is transparent, very light, and does not steam.

All operative measures are categorically contra-indicated during the active period of the disease.

Cold applications are of the utmost importance. Their application must be unremitting night and day, and for this reason two or even three trained nurses are necessary. Thin compresses, chilled in ice water, should be placed upon the closed lid, being renewed about every five

[1] Cf. *Jour. Am. Med. Assn.*, 1909, LIV, 876.

minutes night and day. The cold must not be too intense during the decreasing stage, as it may interfere with the nutrition of the cornea—an interference which manifests itself by a misty appearance commencing at the center of the cornea. Should this be noticed, the cold application must be stopped at once.

Cleanliness and *antisepsis* must be constantly assured by gently separating the lids and freely instilling with a dropper (not a syringe, for fear of spattering the pus into the eye of the attendant), argyrol in such strength as the patient can bear (usually 20 per cent); a few minims being dropped into the inflamed eye every half hour or every hour until the acute inflammation begins to subside and the discharge becomes mucopurulent. Thereafter 2 per cent nitrate of silver solution is applied once or twice a day until gonococci can no longer be found in the secretions.

SYSTEMIC OCULAR GONORRHEA

The various lesions that may occur in the eye as a result of systemic gonorrhea are enumerated as follows by Byers[1]:

Iritis (Mackenzie), conjunctivitis (Fournier, 1866), iridochoroiditis (Koeniger, 1872), keratitis (Colsmann, 1882), panophthalmitis (Martin, 1882), optic neuritis (Panas, 1890), dacroadenitis (Panas, 1894), retinitis (Burckhardt, 1894), tenovitis (Puech, 1895), thrombosis of the retinal vessels (Galezowski, 1900).

Iritis and Iridocyclitis.—The lesion is not very common. Lapersonne saw one or two cases among 2,000 eye cases and Kurka two in 20,000. In Byers's cases it was always preceded (62 cases), accompanied (9 cases), or followed (10 cases) by gonorrheal rheumatism. It was unilateral in 48 cases, bilateral in 23 in the first attack; unilateral in 16, bilateral in 3 in relapses.

Byers recognizes the following types: Iridocyclitis (mild or severe), plastis iridochoroiditis (which may exceptionally proceed to suppuration), exudative, relapsing, and hemorrhagic iritis.

The lesions are not clinically distinguishable from similar lesions due to other cause except by the concurrence of genital and joint gonorrhea or by the complement fixation test.

Conjunctivitis.—The lesion was bilateral in 42 cases, unilateral twice. In 35 per cent there were other ocular lesions, usually keratitis.

The symptoms are rather mild, the secretion usually mucoid or mucopurulent. There was conjunctival edema in half the cases, swell-

[1] "Gonorrheal Ocular Metastases," Montreal, 1908. The statistics throughout are from this monograph. In each case the name of the discoverer and the date of discovery are placed in parenthesis.

ing of the lids in only 10 per cent. Both ocular and bulbar conjunctivae were usually involved. Gonococci were found in the discharge in many cases. The average duration was two weeks, with five and forty-six days as extremes. Relapses were rare and the prognosis good.

Retinitis.—The lesion is a neuroretinitis (bilateral six times, unilateral five times). Six of Byers's cases recovered and three terminated in atrophy.

Other Lesions.—The other ocular lesions of systemic gonorrhea enumerated above are rare and occur as complications of iritis or conjunctivitis.

Diagnosis.—The diagnosis of these lesions as gonorrheal depends almost solely on the concurrence of genital gonorrhea and gonorrheal arthritis and on the complement fixation test.

The discovery of gonococci in the secretion from the inflamed conjunctiva proves the nature of the lesion, but may leave doubt as to whether gonorrheal conjunctivitis is systemic or local. Systemic conjunctivitis is likely to be mild, bilateral, and accompanied by other ocular lesions; it is always associated with genital gonorrhea and gonorrheal arthritis. Local, virulent conjunctivitis, on the other hand, is not associated necessarily with any other lesions of the disease, and is usually an intense, unilateral inflammation.

Treatment.—Instillation of 20 per cent argyrol solution every three hours is of benefit for systemic conjunctivitis. Other local treatment is along general lines; e.g., atropin for iritis, etc.

The urethra must be vigorously attacked, as in every type of systemic gonorrhea.

The toxins or serum should be administered, though they have not proven very successful.

CHAPTER XIV

GONORRHEAL VULVOVAGINITIS IN CHILDREN

By Dr. E. D. Barringer

This disease is generally found in the children of the poorer classes, where overcrowding and unhygienic surroundings predispose to its transference. Dirty towels, soiled linen, etc., are the usual media of contagion; often a direct history can be traced through the mother who is unaware of the nature of her leukorrhea to the father who has an active gonorrhea. Trentwith [1] states that 50 to 75 per cent of his cases showed the father to be indirectly responsible for the infection.

In hospitals, asylums, and especially nurseries, an epidemic is often due to lack of recognition of the nature of the discharge and carelessness in handling it.

Such epidemics in institutions may usually be traced back to one or two children. Sheffield showed that one little girl with vulvovaginitis conveyed the infection through the medium of a large bath tub, in which twenty to thirty of the children had been bathed at one time.

Though epidemics of gonorrhea in children occur in the above-stated manner, many individual cases are due to rape. In the crowded tenement districts this is not an infrequent occurrence, probably arising in many cases from the prevalent superstition that coitus with a virgin will cure an attack of gonorrhea.

Yet this infection is by no means confined to the children of the poor. Oftentimes most virulent and intractable cases have been found in a fashionable girls' school, or in the home of luxury, where the disease has occasionally been traced back to the erring nursemaid.

The prevalence of this infection among children has been estimated in various clinics where these children have been brought for treatment. Welt-Kakel [2] reports that in ten years, 1893-1903, in her service at the Mount Sinai Hospital Dispensary she had 190 cases (1.6 per cent) of vulvovaginitis among a total of 11,578 cases treated. She further states that "Pott mentions 1 per cent, while Henock found 1 in 1,500 children. The statistics of the Armenkinderspital in Pesth shows a percentage of 0.7 per cent among 32,875 children; at the Armenkinderspital in

[1] *N. Y. Medical Journal*, February 3, 1906.

[2] *N. Y. Med. Jour. and Phila. Med. Jour.*, October 8-29, 1904.

Graz, 15 cases of gonorrheal vulvovaginitis were found in the year 1890 in a service of 4,501 children, while Seiffert found among 3,414 sick children at the Polyclinic 22 cases." Dr. Welt-Kakel states her cases did not occur epidemically, but were isolated cases which presented themselves during her service.

Morbid Anatomy and Pathology.—The organ most usually involved in children is the vulva.

The vagina also is usually involved, and the area of greatest inflammation is at the vaginal outlet, around the hymen, where the gonorrheal discharge passes over the perineum.

The gonococcus rarely burrows beneath the deeper layer of the epithelium.

The gonococcus is usually found in the discharges.

Symptoms.—The incubation period of gonorrhea seems, on the whole, to be of shorter duration in children than in the adult; three to four days is the time given by Cohena-Brach and Luczny (Welt-Kakel).

The child first complains of pain on walking, or of a burning or "itching" on urination, and the mother notes a discharge.

There is usually considerable edema of the labia majora, which are more or less stuck together with the copious purulent discharge which pours out from the vagina. Underlying the dried discharge there are often erosions, which bleed easily—the inflammatory condition may extend to the skin surrounding the vulva and may affect the inner aspects of the thigh. And there is often an accompanying inguinal adenitis.

On gently separating the labia pus is usually found oozing through the vaginal outlet. If the pus be wiped away and the child cry or cough, often more pus will be expressed through the opening, showing that the vagina is involved.

In cases due to violation the accompanying trauma may be very considerable—the hymen may be ruptured or the whole perineal floor torn through. In one such case observed by me the traumatism was so extreme that the whole perineum was destroyed and the vulva black and gangrenous appearing. (The child in this instance was in shock when first seen.)

In many cases of violation there has not been any penetration and the hymen may be quite intact. Bandler states that by playing a stream of water under mild pressure against the hymen the delicate, fringelike edge can be examined to see if an injury has been inflicted.

By inserting a very small Ferguson speculum (modification by Bandler) or a Kelly speculum No. X, with the child in the knee-chest position, the vagina can be entirely examined, and the cervix brought into view and inspected as to discharge.

In the ordinary uncomplicated cases of vulvovaginitis there is, as a

rule, only a slight, if any, elevation of temperature, and but mild constitutional disturbance.

Diagnosis.—The finding of the gonococcus in the discharge establishes the diagnosis. In view of present uncertainties in regard to the bacteriology (of vulvovaginitis) it would not seem sufficient to base a diagnosis on a smear showing a Gram-negative diplococcus. Before pronouncing a final diagnosis a culture should be made. This should be insisted upon in cases of possible medicolegal import. A sufficiently accurate working diagnosis for clinical purposes, however, can be made by the finding of the Gram-negative diplococcus in a smear taken from a given case.

Differential diagnosis must be made from noninfectious vulvovaginitis, which arises from a variety of causes, such as lack of personal cleanliness, soiled diapers, decomposed smegma, sweat, urine, the oxyuris, or pin-worms from the rectum. In hot weather, and especially with exercise, these conditions arise more readily.

There is also the so-called "catarrhal" form of vulvovaginitis, which clinically resembles gonorrhea, but does not show the gonococcus; the bacteriology of this other still seems to be obscure. This form, however, is infectious.

Noninfectious vulvovaginitis may complicate some of the infectious diseases; e.g., measles and scarlet fever.

Course of the Disease.—The acute inflammatory stage usually lasts from four to six weeks. After this the discharge is apt to change in character from a profuse thick to a thin serous flow and the case to become subacute or chronic. The duration of the disease varies greatly; many cases extend over a number of years. The average time for cure has been variously estimated at four to six months.

In children as in adults gonorrhea is prone to relapse. Often after an apparent cure the trouble starts up suddenly, and gonococci reappear in the discharge.

Complications.—The complications of vulvovaginitis are very numerous. Though extension of the infection to the bladder is rare in children, Wertheim has reported a case of true gonorrheal cystitis in a little girl, where the gonococcus was found in a piece of bladder mucous membrane removed by an operating cystoscope.

Extension of the infection from the cervix through uterus and tubes on into the peritoneum may give any of the surgical complications which the gynecologist finds in the adult, as salpingitis, pyosalpinx, or purulent peritonitis. These cases are often diagnosticated as appendicitis, but examination of the vaginal secretion usually reveals the gonococcus. The course of a pure gonorrheal peritonitis is usually more favorable than that of a mixed infection.

Extension of the gonorrheal process to the anus and rectum may take

place. Arthritis is one of the more frequent complications; gonorrheal conjunctivitis also. In fact, any of the systemic manifestations of gonorrhea may occur. Sequelae are usually adhesions of the uterus, tubes, and ovaries.

Treatment.—In the early stages, while there is edema of the vulva and profuse discharge, it is preferable to keep the child in bed. The mother or nurse should be instructed in the careful handling of all infectious materials.

The diet should be light, avoiding any highly seasoned food and plenty of fluid should be taken. The bowels should be kept freely open. Once or twice a day the child should be put in a warm sitz bath.

If the discharge is confined to the vulva or is very profuse there, it is well at first to confine the irrigations to the vulva only.

The degree of vaginal involvement can be fairly well estimated by the method mentioned above—wiping away the pus over the vaginal opening and observing if more pus oozes down when the child cries or strains.

The irrigation used for the vulva should be copious hot flushings of a 2 per cent boric acid solution while the inflammation is very acute. This should soon be changed to a bichlorid of mercury (1:10,000-5,000) solution, lysol ($\frac{1}{2}$ to 1 per cent) or potassium permanganate (1:2,000).

If the vagina is obviously badly involved from the first, vaginal douches should also be given without delay, the above solution (slightly diluted) being used, and two quarts used at a time.

The best douche outfit is a soft-rubber catheter, No. 15, F., attached to a glass irrigating jar or ordinary fountain bag. The pressure should be mild.

The child is placed in the dorsal position over a Kelly pad douche pan. The catheter should be introduced with great care so as not to injure the delicate hymen. The douches should be given twice or thrice daily, oftener if needed to wash away the discharge.

After each douche the vulva should be gently dried and[1] ointment applied so as to protect the delicate skin from the excoriating effect of the discharge.

A light absorbent vulva dressing should be applied and held securely in place between treatments so as to avoid any conveyance of pus to the eyes by means of the child's fingers.

After the first acute stage is over, the vulva should be painted thoroughly with argyrol 5 to 25 per cent, protargol 2 to 4 per cent, or silver

[1] Zinc oxid ointment has been found by some to be very useful for this purpose; others recommend an ointment containing one of the silver salts as a 2 per cent protargol ointment (Baudler). The writer has found the use of these silver ointments to be most efficacious.

nitrate 1 per cent. The vagina should also have instillations of any of these solutions, treatment to either vulva or vagina being given once a day immediately following the douching. The instillations into the vagina can be made readily by the use of a glass medicine dropper.

Gradually the daily treatments can be changed to thrice and then twice weekly. If the vaginitis persists, it may be necessary to give direct applications to the vaginal or cervical mucous membrane.

These applications should be made with the child in the knee-chest position and by means of a small Ferguson or Kelly No. X speculum. The hymen should be anesthetized by a pledget of cotton soaked in 2 per cent alypin, which is allowed to remain there for five to ten minutes. Light is thrown in by means of a hand mirror and the cervix or vagina examined carefully.

Erosions of the cervix or vagina can be touched up with a 3 to 5 per cent silver nitrate solution, and if the vagina is extensively involved it may be filled with a 1 per cent silver nitrate solution, which is allowed to remain there for a few minutes.

As improvement takes place the silver irrigation can be replaced by zinc-sulphate irrigation (solution to about $\frac{1}{8}$ per cent strength) or zinc and alum (3j) to water (Oj).

From time to time the discharge should be examined for gonococci and active treatment continued so long as these are found.

When the discharge no longer shows them and the complement fixation test becomes negative a tentative cure may be pronounced and treatment stopped.

In view of the tendency of the recurrences, it is wise to reëxamine at intervals of months and later every year or two. Of course this is only practicable where the physician has the coöperation of an intelligent parent or guardian.

Prophylaxis.—The safeguarding of children of the community from the ravages of gonorrhea seems so vital a duty that it is only necessary to mention the more important ways in which this can be furthered.

All adults in active gonorrhea, especially those who have children, should be warned of the great infectiousness of the disease and that little girls are apt to contract it. Specific instructions should be given in regard to the destruction of all soiled dressings, proper disinfection of hands, and importance of separate sleeping and toilet arrangements.

Violation is a crime which should be followed up more severely by the hand of the law. It should be a matter of civic responsibility to see that these cases are brought to justice. And yet one familiar with the tragedies of the slums often sees these cases sink into oblivion with no questions asked.

In hospitals, asylums, day nurseries, or institutions where children are congregated, the utmost care should be taken in regard to the admis-

sion of children with leukorrhea. Many of the leading hospitals at present will not admit a girl to their children's wards without taking a vaginal smear.

When gonorrheal vulvovaginitis has once gotten into such an institution the most careful and intelligent isolation and treatment should be carried out.

If possible such cases should be isolated as completely as measles or scarlatina. Where separate nurses are not possible, extra precautions should be taken to insure asepsis in going from one case to the next. All thermometers, towels, douche outfits, bath tubs, and toilet articles should be kept separate for these cases and should be scrupulously disinfected before and after using. The nurses should be especially instructed in the disinfection of their hands and be provided with rubber gloves if possible. Where the babies are still in the diaper age, gauze dressing, which can be destroyed, should be substituted. Diapers or dressings of any kind which are used again should be most carefully boiled.

Dr. Holt has drawn attention to the fact that one of the most trying features about prophylactic measures is the length of time they must be persisted in.

CHAPTER XV

GONORRHEA IN WOMEN

By Dr. E. D. Barringer

There is probably no infection which appears in a greater variety of forms to tax the skill and judgment of the medical practitioner than gonorrheal infection in the female. Its almost infinite variety of clinical pictures, its frequently obscure onset, its insidious progress, make it often difficult of diagnosis. Again, the sociologic questions which accompany this infection still further complicate the problem of treatment.

It is of importance to consider some of the causes which have combined to make this infection in the female sex so much more of an elusive factor to deal with than in the male. Foremost of these is the actual anatomical difference in the conformation of the genito-urinary organs of the two sexes.

In the female the extent of mucous membrane which may be involved is enormous in comparison with the male. The vulva with its intricate folds, the urethral orifice with its glands, the vagina and cervix, around which the gonococci are usually deposited, the uterus with its endometrium rich in glands, the fallopian tubes, the ovaries, to the peritoneum, present one continuous trail for gonorrheal invasion.

Again, as this disease practically always results from sexual intercourse, and frequently from illicit intercourse, the question of gonorrhea has gone hand in hand with the history of prostitution. The sociologic problems surrounding prostitution are necessarily intricate. Man and woman hold entirely different positions in regard to it. The man who transgresses has but little thought, other than perhaps a preliminary burning of conscience, of the moral side of the transgression. His one thought is to seek consultation in order to rid himself of the disease, and when cured he is no better nor worse than the small percentage of his fellows who have not transgressed. He belongs to the majority.

On the other hand, the woman who transgresses is an outcast. Her one thought is neither to seek advice nor consultation, but to hide everything.

The causes for these two points of view are probably on the one hand man's aggressive nature, his ability to create public opinion, and

on the other hand woman's passive acquiescence to these created standards.

It is this man who has transgressed, who has had experience, who marries. Therefore, when any question of gonorrheal infection comes up after marriage his experience is pitted against his wife's ignorance in disguising the real condition of affairs. And if strange and overwhelming disease comes to the woman after marriage, not realizing what causes might be responsible, she has been taught to believe that this suffering is woman's portion and has accepted her lot. That woman is monogamous by instinct has not a little to do with this point of view.

Not so with the man; if he has reason to believe he may have gonorrhea, at the outset of the first symptoms he consults a physician and the physician must be ready with prompt and efficacious treatment if he would hold this patient. Out of this situation have arisen numerous methods or schools of treating acute gonorrhea in the male, and this treatment has reached a stage of great perfection, because the demand for such treatment has been insistent.

With his female patients the physician has been put under no such pressure for diagnosis, and while he has achieved lasting fame in the treatment of the later surgical complications of gonorrhea in the female, he has often gone in the line of least resistance in making a diagnosis of gonorrhea in its early stages. The woman, not suspecting what may be at the bottom of her slight indisposition, has too often been reassured by the statement, "Oh, the discharge is only the result of marriage relations." "You have taken a slight cold in your bladder," etc. She goes home and neglects herself, and returns to her physician only when symptoms have sufficiently asserted themselves so that he can make a *clinical* diagnosis of gonorrhea. As a result many a case of acute gonorrhea in the female is grossly mishandled and swells the lists of those cases later demanding surgical skill.

When, therefore, the possible gonorrheic presents herself for consultation, the conscientious examiner must tactfully approach his task and attempt to find out in which one of the following classifications this particular woman belongs.

First: Is she a married woman who has innocently contracted the disease, knowing nothing of its nature? If so, the economic question of not destroying the marriage relation presents itself.

Second: Is she an unmarried woman who has contracted the disease as a result of illicit intercourse? If so, is she a "first offender," unaware of the enormity of what she has done, or is she a prostitute?

Third: Is she an unmarried woman who is quite innocent of any sexual relations, and has had the misfortune to contract the disease by the use of infected linen, toilets, douche outfits, or dirty instrumentation?

Fourth: Is she perhaps one of the victims of a former infant gonorrhea?

Fifth: If the patient be a little girl, has she become infected from some unrecognized source in her own family?

The importance of a correct diagnosis at once becomes apparent:

1. For the safety of the family or community. If the innocent woman is infected she must be instructed how to take care of herself, as she may infect other members of her family or her own eyes. If the patient be a prostitute, she must be warned that she is in an infectious state.

2. In justice to the individual. It is only necessary to mention how important it is to know *what* germ is responsible for the infection. It may mean the ruin of an innocent woman's life to be labeled gonorrheic when an entirely different cause could be found on investigation.

3. For the purpose of intelligent treatment and prognosis.

ETIOLOGY AND PATHOLOGY

The various clinical manifestations of gonorrhea in the female vary in accordance with the following conditions:

1. The *virulence* of the infecting gonococcus.

2. The *resistance* of the tissues which are invaded.

3. Whether the original infection is a *mixed* infection; i.e., the pyogenic organisms are present as well as the gonococcus.

4. The *raising of the virulence* of the original infection by certain processes in the woman. (This accounts for many cases of so-called "one-child sterility.")

Döderlein[1] says:

"Clinical experience and bacteriological investigations have given rise to the following important conclusions respecting the etiology and pathology of gonorrhea:

"A wide patulous external urethral orifice in the male favors the entrance of the female secretion; so that one with such a urethral orifice may acquire gonorrhea, while another—later comer—may not acquire it.

"Likewise in the female the anatomical conformation of the genitalia has an influence on the kind of gonorrheal infection; with a narrow vaginal outlet, virginal, the urethra is likely to become infected; and in a non-virginal vagina the infecting agent more easily comes in contact with the upper part of the vagina and cervix. Infection with acute gonorrheal pus causes in women a much more acute, stormy attack of ascending gonorrhea (Wertheim) than an infection with chronic, latent gonorrhea.

"In labor the gonococci in the lochia become more virulent, which favors an ascending infection.

"In marriage the two participants may become immune to each other's gono-

[1] Küstner, *Lehrbuch der Gynäkologie*, 1904, p. 389.

cocci. So that it is not possible to have a further exacerbation of gonorrhea between these two. When a third person trespasses, however, it is possible that he may have an attack of acute gonorrhea, while neither the man nor woman have any manifest gonorrhea (Wertheim). Not every connection with a gonorrheic woman is followed by an infection, because in chronic gonorrhea the genital secretions can at times be free of gonococci. Marked irritation of the genitals, menstrual or puerperal secretions bring the gonococcus to the surface, and so raise the infectiousness of the woman. Under these conditions the symptomless gonorrhea of man can experience a recrudescence, and the man can through his wife be infected with a virulent gonorrhea.

"In man, latent, i. e., symptomless yet infectious gonorrhea can, through excesses, especially those venereal (marriage), experience exacerbations and appear after a pause of perhaps ten or twenty years."

I absolutely disbelieve this.

The organs covered by pavement epithelium are more resistant to the gonococcus than those covered by cylindrical epithelium, and the organs therefore most frequently involved in the order of frequency are the urethra, cervix uteri, posterior vaginal vault (where the infected cervix comes in contact with the vaginal wall), the vulva, and the remaining portions of the vagina.

There are further certain spots of predilection where the gonorrheal infection is apt to settle and become chronic, i.e., Skene's glands and Bartholin's glands. At the opening of the ducts leading from Bartholin's glands two small reddened spots can be seen when the ducts are infected with gonorrhea. These spots are called the "maculae gonorrhoicae" (of Sänger[1]).

THE HISTORY OF THE CASE

By inquiring carefully into the history of a given case and the probable mode of infection much valuable assistance can often be gained.

Thus, if no history of sexual intercourse is obtained and it is found that the patient has been using toilet articles, towels, etc., which might be a source of infection, the inference may be made that the infection is chiefly external around the vulva, urethra, and vaginal outlet.

Again, as sometimes occurs in dispensary practice, if a history is given of attempted intercourse (rape) in which the act was not accomplished, a similar observation may be made.

Also in newly married women a history of incomplete intercourse may be obtained, and especially in cases where precautionary measures against conception are used, as withdrawal or the use of protectors, one may again expect to find a low infection around the vulva or vaginal outlet.

[1] *Centrlbl. f. Gyn.*, 1896, p. 1073.

SYMPTOMS

The patient usually complains of a profuse burning discharge and difficult burning micturition.

These two symptoms in a woman who has previously been well suggest at once a possible gonorrheal involvement, the more so if coupled with a history of any of the above mentioned modes of infection.

Other subjective symptoms may be given, as, for instance, pain when walking or sitting, sense of fullness and weight in the groins, small of back, or at the vaginal outlet, or occasionally the patient may report a bloody urine if the bladder involvement is marked.

An examination of the affected parts will give the further objective symptoms necessary to make the diagnosis. The details of the first examination will vary directly with the history obtained, and the virulence of the infection as observed when the vulva is inspected.

If the history of a probable low infection has been obtained, and an acute condition of the vulva and urethral opening is found, a smear of the discharge should be taken by means of a sterile platinum loop for examination and no further examination made until the acute external inflammation has subsided. The patient should be kept in bed (*see* Acute Urethritis).

If the patient gives a history of a probable high infection and complains of pain in the region of uterus or tubes, and this is verified by abdominal palpation, a careful bimanual examination should be made at once, for the case may call for immediate surgical care.

Should the patient come with the history of a subacute or chronic infection, the following routine examination should be made: the patient should be instructed *not* to take a douche before submitting to the examination. In this way the characteristics of the discharge can be noted.

The vulva should be inspected carefully; oftentimes venereal warts are found around the anus or vaginal outlet. The labia majora should be spread apart and search made for the maculae gonorrhoicae at the openings of Bartholin's glands. By slipping the index finger into the vagina for about one-half inch and placing the thumb over the macula, oftentimes an induration or abscess of Bartholin's glands can be palpated. Should any pus exude from the ducts a smear and culture should be made and laid aside for examination. Examination of the urethral orifice should next be made. If a free discharge of pus be found in the urethra, a smear and culture should be taken, and then the urethral orifice carefully wiped off, and an examination made of Skene's glands. Again, by passing the index finger into the vagina and running it up toward the bladder end of the urethra and then massaging the

urethra toward its outer end, a tiny drop of pus can oftentimes be expressed for a smear and culture.

The vaginal outlet should next be inspected, and if a discharge is found to be coming down from above, a further examination should be made with a speculum.

When the examination is made, great care should be taken to cleanse the vaginal outlet of all discharge, so that no infection be mechanically carried from outside upward to the cervix.

When the cervix is well exposed by the speculum specimens should be taken from the discharge found around the external os. The cervix is carefully inspected and then the posterior vault of the vagina for any erosions of the mucous membrane produced by contact with the infected cervix.

After the speculum examination is completed, a careful bimanual palpation should be made. With reference to the condition of the uterus and adnexa, special note should be made as to the size, position, mobility, and *sensitiveness* of the uterus; as to whether the tubes are enlarged or tender and as to whether perimetrium or parametrium is involved. If an advanced or urgent condition of the pelvic organs be found, the case may have already passed over into the domain of surgical gynecology.

VARIETIES

ACUTE URETHRITIS

Urethritis is considered the most frequent form of gonorrheal infection of the female genitalia. This is probably due to the fact that in the beginning of the sexual act the labia majora are pushed apart by the glans penis, and the urethral orifice in this way is put on the stretch. The ducts of Skene's glands, lying inside of the urethral orifice, are then brought in direct contact with the infecting discharge from the male urethra, as is the lining epithelium of the female urethra. And as this epithelium is columnar, the infection readily takes place.

Symptoms.—The patient usually complains of an intense burning discharge at the urethra and a sense of burning or "sticking" pain on micturition. Sometimes there is a marked tenesmus or even retention if the patient is nervous. She may note that she passes a few drops of blood at the end of urination.

Examination generally shows an intensely reddened urethral opening, oftentimes with the swollen mucosa bulging out of the orifice, giving the appearance of a prolapse. Pus is seen oozing down over the mucosa. The orifices of Skene's glands may be conspicuous or they may not be demarcated from the rest of the violently congested mucosa.

Palpation of the urethra *per vaginam* (care being taken to carry

none of the pus up with the examining finger) gives acute tenderness. Oftentimes the urethra feels like a cord under the finger.

Diagnosis.—Diagnosis is not difficult if a careful history has been elicited; a smear taken of the discharge should show gonococci. *Urethritis* following infection by catheterization can usually be excluded by the history and the absence of gonococci in the smear. *Urethritis* caused by the irritation of concentrated urine, chemical irritants, traumatism, or the exanthematous diseases can usually readily be excluded by the history.

Treatment.—Rest in bed and absolute cleanliness are essential in treating acute urethritis. The attendant should be warned of the infectiousness of the discharge and all soiled dressings destroyed. Three or four times a day the urethral orifice and vulva should be gently flushed off with copious hot irrigations of boracic acid solution or bichlorid of mercury 1: 6,000 or lysol ($\frac{1}{2}$ to 1 per cent). These irrigations can be given by means of a fountain syringe with the patient in the dorsal position on a douche pan. After the irrigation, the vulva should be covered with an absorbent pad. The diet at first should be mainly liquids—milk, broths, and nonirritating foods. Condiments and alcohol in any form should be absolutely forbidden.

The patient should be encouraged to drink large quantities of water.

If the irritability and tenesmus is marked, a urinary sedative should be administered (p. 220):

As the most acute symptoms subside local applications should be made to the urethral opening after the irrigation has been used. Two to four per cent protargol freely applied by means of a swab, around the urethral mouth and openings of Skene's glands may be very helpful. Argyrol (10 to 25 per cent) can also be used. These applications can be made once or twice a day. A certain number of these cases respond promptly to treatment, and make an excellent recovery; but, unfortunately, many pass into the subacute or chronic state.

As many cases of acute urethritis are combined with cystitis, it is often necessary at the outset to start bladder irrigations (*see* Acute Cystitis).

CHRONIC URETHRITIS

Usually a history of an acute attack is obtained, but occasionally the patient becomes aware of her condition only when it is subacute or chronic. The urethra may alone be involved or there may be an accompanying cervicitis or cystitis. The discharge in these cases shows as a rule pus and epithelium cells and pyogenic organisms, the gonococcus often being found with difficulty.

Symptoms.—Frequency of urination is the symptom most often found. This frequency occurs during the day when the patient is in the upright position, and may also be complained of at night.

In milder cases the patient complains of an occasional "tickling" or "burning" on urination, and this may be very intermittent in character.

Examination.—By massaging the urethra through the vagina a thick mucopurulent secretion can be obtained. This, when examined microscopically, may be found to consist of epithelium and pus cells and no gonococci present. The urethra in these chronic cases is generally found somewhat indurated and tender on palpation. After the urethra has been emptied of its secretion and this wiped off, a more thorough massage over Skene's glands may bring a tiny drop of pus to each duct. Oftentimes the gonococcus will be found here when it has disappeared from the urethral discharge proper.

It may be of value to ascertain whether the anterior or posterior portion of the urethra is chiefly involved. By massaging first the anterior portion and later the posterior a rough estimate of the involvement can be obtained. Examination by the endoscope may show local areas of congestion and erosion in the course of the urethra.

Treatment.—The general treatment is the continuance of a simple diet without the use of condiments or alcohol. The internal drugs commonly used are the same as prescribed for male patients (*see* p. 218).

Local treatment is accomplished by the application of the various silver salts to the urethral mucosa. This can be done by means of a glass medicine dropper or by bladder irrigations (p. 207).

These treatments should be given three times a week, later twice a week. If localized erosions are discovered these should be touched up with silver nitrate (5 per cent) with the aid of the endoscope.

If this process is painful, it may be necessary to first anesthetize the urethra. This can readily be done by inserting a fine applicator wound with cotton dipped in alypin, 5 per cent.

In certain resistant cases the application of urethral pencils is very useful. These are variously prepared, containing various medicaments, as silver nitrate, protargol, argyrol, ichthargen, or astringents such as zinc sulphate. Astringents are of great value in the later stages of urethritis.

These pencils have the double value of acting mechanically as a small sound to dilate the urethra. They should be lubricated with a sterile lubricant before inserting.

Complications.—If persistent involvement of Skene's glands continues long after the urethritis has been controlled, it may be necessary to split open these little glands; this can be done by means of a fine scissors under local anesthesia; the glands and duct should then be swabbed

out with carbolic acid (95 per cent), followed by alcohol, or with a strong 30 to 50 per cent silver nitrate or silver stick.

Caruncles may form in the irritated and hypertrophied mucous membrane around Skene's glands.

Stricture of the urethra is relatively rare in women and should be treated by dilating with a female urethral sound. Care should be taken that the dilatation is not too great, as the urethral wall may easily be injured. Dilatation up to 28 to 30 F. is sufficient.

CYSTITIS

Gonorrheal cystitis or cystitis arising from catheterization (e. g., in postoperative retention) is more frequently seen in women than in men.

Catheterization should in all cases be followed by an antiseptic irrigation and the catheter of election is the glass one.

The symptoms, diagnosis, and treatment of cystitis are discussed in Chapter XXXVIII.

ACUTE CERVICITIS

Next to the urethra, the cervix is considered the organ most frequently infected by gonorrhea.

There are two reasons for this: the cervical mucosa is columnar in type, therefore especially prone to gonorrheal infection; and secondly, during coitus the seminal discharge is poured directly over or around the cervix.

In a large percentage of cases the cervix and urethra are involved at the same time; it is rare to see a gonorrheal cervicitis without a urethritis, but the reverse is not true.

Symptoms.—There is generally a sense of fullness or weight in the region of the vagina and a discharge. If the body of the uterus is involved there may be considerable pain in the hypogastrium.

Examination.—Examination shows the cervix much reddened and covered with more or less purulent discharge. A smear usually shows the gonococcus. On wiping away the discharge the mucous membrane may show bleeding points or erosions and the cervix may appear edematous.

Diagnosis.—Diagnosis must be made from the ordinary form of cervicitis such as is found with a laceration of the cervix due to childbirth; or cervicitis due to passive congestion, as in certain displacements and stenosis of the cervix.

Carcinoma of the cervix is differentiated by the examination of excised portions of tissue in doubtful cases.

Involvement of the mucous membrane in any of the exanthematous diseases can be differentiated by the presence of other symptoms.

Syphilitic mucous patches can also be excluded by the history and clinical findings, although these cases are sometimes very puzzling and a double infection may be found.

The same is true of chancres and chancroids. The finding of the Spirochaeta pallida or the bacillus of Ducrey may establish the diagnosis.

Treatment.—Some physicians are averse to douching in the most acute stages of cervicitis, as they claim that there is danger of negating the value of the acid secretion of the vagina which is a natural safeguard.

If the cervix is actually involved, it seems, in the opinion of the writer, better judgment to keep mechanically removing the constantly accumulating discharge than to allow it to remain in contact with both the affected and unaffected mucous surfaces.

Therefore copious hot irrigations of a mild antiseptic solution are advised, under low pressure, so that there shall be no driving of the discharge farther up into the cervix.

Boric acid solution (2 per cent), lysol (1 per cent), bichlorid of mercury (1: 5,000 to 10,000), permanganate of potassium or creolin ($\frac{1}{2}$ per cent) are used. These irrigations should be given two or three times daily or oftener if the discharge is very profuse.

CHRONIC CERVICITIS

This may follow an acute attack, or the onset may have been so chronic in character that the patient has not been aware of its existence. The history is often of very little value, and the diagnosis, even after a most careful examination, may only be presumptive, unless perhaps some complication (as salpingitis) arises, which proves the diagnosis.

Gonococci are often not found in the discharge, this discharge being composed only of pus and epithelial cells.

In these cases an examination should always be made just after menstruation, as the mucosa at this time is more congested and the desquamation of the mucosa favors the throwing off of the deeper glandular secretions and the gonococci which have penetrated to these deeper structures.

The fact that the discharge after menstruation may be more infectious than at other times has undoubtedly given rise to the popular superstition that gonorrhea may be contracted from intercourse during the menstrual period.

Symptoms.—The usual symptom is a discharge. This may be very slight and be practically the only symptom, or painful urination may be found if urethritis is present also. There may be disturbances of men-

struation if the endometrium is involved. Again, sterility may be the only complaint.

Examination usually shows a coexisting urethritis with involvement of Skene's glands and the maculae gonorrhoicae. However, occasionally these are all absent and the one pathological condition found is around the cervix. Here the mucosa may be somewhat reddened and a discharge varying in type be found. It may be thin and watery or thick and purulent—yellowish or green in color. There may be slight eversion of the cervical mucous membrane through the external os, and erosions which bleed more or less easily may be found on the cervical or posterior vaginal mucosa. The cervix may appear swollen and boggy and tiny varicose vessels may be seen around the os.

Diagnosis.—If erosions are present on the cervix, even if the gonococcus be absent, a diagnosis can be made by the complement fixation test.

Treatment.—Local applications to the cervix are especially indicated. The cervix should be brought into view by means of a bivalve speculum and then carefully examined. If erosions are present they should be wiped off with sterile cotton and then touched up with silver nitrate (10 per cent), Churchill's tincture of iodin, or plain tincture of iodin. Care should be taken not to carry any instrument up through the internal os, as in this way the endometrium may be infected. It is often advantageous to immerse the entire cervix in a solution so as to reach all the parts involved.

The Ferguson speculum is useful for this and it should be inserted until the cervix is in view, the solution poured in, and the speculum partially withdrawn. By so doing the cervix is dipped into a pool of solution and allowed to remain there for a number of minutes (five to ten minutes), and then the speculum is pushed into the original depth and depressed, when the fluid is easily drained out.

Silver solutions most frequently used are silver nitrate 3 to 5 per cent, protargol 2 to 10 per cent, argyrol 10 to 25 per cent.

In some cases, where the tissue seems boggy and congested and the inflammatory condition is not so marked, instillation of zinc salts in the manner described above is useful.

After the cervix has been treated in one of the above-mentioned ways, a tampon of boroglycerin (10 per cent), or ichthyol and glycerin (10 per cent) may be used; or a dry tampon sprinkled with aristol, dermatol, or iodoform may be placed against the cervix.

In cases where the discharge from the cervix is very profuse it is better not to use tampons at first, as they may dam back the discharge against the cervix. In the presence of a vulvitis it may be necessary to tampon, and if so special precautions should be taken (*see* p. 151).

In chronic cervicitis the above treatment should be given in the office, at first three times a week and gradually reducing the frequency of treatment as the symptoms improve.

Douches should be ordered as home treatment, at first once or twice a day and later two or three times a week. In some cases the treatment may be hastened by the home use of suppositories containing various medicaments, ichthyol, protargol, zinc, etc. These can be inserted by the patient every other night or less often. The solutions for douching should be mild antiseptics or astringents as used in the office.

ACUTE VAGINITIS

The vagina in the adult is one of the most resistant parts of the genital tract, as it is covered with pavement epithelium; and further, through the trauma occasioned by intercourse and childbirth, it becomes to a certain degree toughened and not easily infected. But the vaginal membrane readily becomes involved in young girls, whose mucosa is delicate, or in newly married women, whose mucosa is not hardened by congestion and trauma.

When the gonorrheal infection is hyperacute the entire genital tract may be involved in one continuous infection, and in these cases the vagina is not exempt.

Acute vaginitis may be primary, but is usually secondary to a gonorrheal cervicitis or endometritis.

Symptoms.—The patient complains of burning and a sense of weight in the vagina, and as the vaginitis is usually accompanied by urethritis and cervicitis, the symptoms of these conditions are usually added. Examination with a speculum in the knee-chest position (observing the precautions, p. 142) shows the vaginal mucosa to be the seat of an acute inflammatory process. The entire vaginal wall may be intensely congested, hot, swollen, and bleeding readily, or it may be bathed in a copious purulent discharge. Erosions with bleeding edges may be found, usually in the posterior fornix or in other portions of the vagina. The gonococcus can, as a rule, be readily found in the discharge.

Diagnosis.—Acute, nongonorrheal traumatic vaginitis is encountered in the newly married and among those who use strong medicated douches as a precautionary measure. These forms of vaginitis, puzzling at first, can usually be very easily differentiated by the absence of gonococci in the discharge and the almost immediate response to treatment when the cause is removed.

Other forms of vaginitis (due to the exanthemata, cervical carcinoma, or simple cervicitis) can be eliminated by the history and findings in each case and the absence of gonococci.

Treatment.—Rest in bed and frequent douches of mild antiseptic solutions should be ordered. In the most acute stages, when the pain is severe, boracic acid douches, at a temperature of 100° to 110° F., under mild pressure, are probably the most beneficial and soothing. These should be given frequently, every two or three hours, if the discharge is profuse, and the utmost care should be taken in regard to asepsis.

If, at the time of the examination, the lower portion of the vagina is found to be the part especially involved, care should be taken to insert the douche tip but 1 to 2 inches into the vagina and flush out only the lower portion.

After the early acute stage is over, lysol or bichlorid of mercury (1 : 15,000 to 10,000) can be substituted, and gradually a daily or twice daily instillation of protargol (4 to 10 per cent) or argyrol (25 per cent) can be made with a glass syringe, the douche preceding this treatment.

Douches should be given sufficiently often to keep the vaginal outlet quite clean and thus preventing a secondary vulvitis. Between treatments absorbent vulva pads should be worn and these changed often enough to insure perfect cleanliness.

CHRONIC VAGINITIS

Usually a history of a previous gonorrheal infection is obtained. Primary chronic gonorrheal vaginitis is rare, for the vagina, on account of its resistance, is about the last structure in the female pelvic organs to become involved, and when it does become the seat of a chronic gonorrhea, usually a profound gonorrheal infection has occurred elsewhere.

Gonococci may have entirely disappeared from the vaginal discharge, which may consist of pus and epithelial cells alone.

Symptoms.—The only symptom complained of may be a slight leukorrhea, or the patient may have more or less pain in the vagina when walking or moving about. On examination with a speculum in the knee-chest position, the vaginal mucosa may be found covered with a purulent or mucopurulent discharge. Localized areas of erosion are usually present, and their presence keeps up the leukorrhea in part.

Diagnosis.—Diagnosis usually requires the complement fixation test, as the gonococci have often entirely disappeared.

Treatment.—The treatment is in the main the same as for acute vaginitis (which see); in these chronic cases, however, the process is often very resistant to treatment. The erosions should be touched up with silver nitrate 10 per cent, or, in some cases, the silver stick or pure carbolic acid, followed by alcohol. Tamponage with boroglycerin or

ichthyol and glycerin is often of great assistance, as is also the use of medicated suppositories. In certain cases the use of brewers' yeast is helpful. Again, a change of treatment to dry tampons covered with aristol or iodoform may bring about the desired results.

ACUTE VULVITIS

In the adult gonorrheal vulvitis is found much less frequently than in the child or young woman. The squamous epithelium of the vulva is more resistant in the adult than the child and the trauma of childbirth and marital relations make it more so.

Symptoms.—However, an acute vulvitis may occur and give very distressing symptoms; the chief of these are intense burning pain, worse on urination, a sense of fullness and weight, and extreme discomfort in the sitting posture or on walking.

Examination of the vulva in these cases usually shows the entire vulva to be the seat of an acute inflammatory process. The labia may be much swollen and edematous, and their inner surfaces bathed in a copious purulent discharge. On separating the labia excoriations of the mucosa may be found and the intensely inflamed surface may bleed easily.

Further examination of the vagina and cervix should be made with the precautions stated above, for occasionally the vulvitis may be primary, though more usually a urethritis and cervicitis also exist.

Diagnosis.—There are several conditions from which gonorrheal vulvitis must be differentiated.

Simple vulvitis, due to lack of cleanliness; this is often found in obese women, especially in hot weather and where there is intertrigo. The absence of the gonococcus in the smear from such a case and its prompt reaction to treatment will easily differentiate this form.

Diabetes often gives rise to a violent vulvitis, due to the decomposition of the diabetic urine by the presence of the torula saccharomyces. The age of the patient and presence of sugar in the urine usually eliminate this form without difficulty.

Vulvitis due to a *vesicovaginal fistula* can be differentiated by the history and the finding of the fistula.

Vulvitis due to a discharge pouring down from a nongonorrheal *cervicitis or vaginitis* may also be very puzzling until the discharge is traced back to its origin and a bacterial examination made.

Vulvitis due to the excoriating effect of the discharge from a *carcinoma* of the cervix or vagina may also simulate acute gonorrhea in its intensity.

Vulvitis complicating any of the *exanthematous diseases* can be differentiated by the history.

Treatment.—Primary gonorrheal vulvitis should be treated by rest in bed and absolute cleanliness. In the acute stage the vulva should be irrigated every two or three hours (if the discharge forms rapidly) with a warm boracic acid solution or a bichlorid of mercury (1 : 6,000) or lysol (½ to 1 per cent), the patient being in the dorsal position on a douche pan, and the nurse gently separating the labia so that the irrigation may reach the internal surfaces of the labia and the vaginal and urethral orifices. After the irrigation has been given, a pledget of sterile cotton covered with sterile vaselin should be placed lightly between the opposed infected surfaces to keep them apart. A protargol ointment (2 per cent) can also be used with benefit.

After one to two days the irrigations may be given less often and three times a day (after an irrigation) the vulva may be painted thoroughly with argyrol (25 per cent) or protargol (4 per cent).

If the vulvitis is secondary to urethritis, cervicitis or vaginitis, the treatment must also include the special treatment of these parts. Oftentimes, when a vulvitis is secondary to a cervicitis, the cure of the vulvitis can be much hastened by sealing off the cervix from the vulva by a dry tampon of sterile cotton after the cervix has been duly treated. In these cases it is very important that the patient be kept under constant care, as these tampons must never be left in long enough to dam back the discharge against the cervix and thus delay its healing.

CHRONIC VULVITIS

In certain cases resistant to treatment, or in cases which have been neglected, a chronic vulvitis may be found.

Symptoms.—Symptoms are discomfort on walking or sitting and more or less discharge on the vulva.

Examination may show certain areas of localized inflammation, especially around the glands of Bartholin, which glands may be indurated or the seat of abscess.

Diagnosis.—Chiefly by the complement fixation test.

Treatment.—If the vulvitis is primary the careful and persistent use of the silver salts will usually cure the condition. All erosions should be touched up with silver nitrate (10 per cent) and the remaining mucosa painted with protargol 4 per cent. After such treatment it may be well to dry the vulva very carefully and to powder it with aristol or dermatol.

Oftentimes zinc sulphate (½ per cent) will accomplish more than the silver salts and should be used alternately if results from the former are not satisfactory.

Suppuration of Bartholin's glands may call for incision and drainage, but if possible it is best to dissect out the infected gland as a whole,

swabbing out the cavity with bichlorid of mercury (1:1,000) and packing with gauze.

COURSE AND PROGNOSIS OF SYSTEMIC GONORRHEAL INFECTION IN WOMEN

Acute gonorrhea is usually seen either in young girls or in the prostitute class, and is characterized by the usual features of an acute infectious disease. After an incubation of ten to fourteen days (which, however, in some cases is as rapid as twenty-four hours) the patient is seized with severe constitutional symptoms, as chill, high fever, and rapid pulse. The local symptoms are, as a rule, very acute and may rapidly invade the entire genital tract, giving rise to acute endometritis, salpingitis, and peritonitis. Metastatic processes are not uncommon in these cases, as involvement of the joints, endocardium, and even meninges.

The course of the acute infection is about six weeks, after which time the case, with careful treatment, may recover or pass into a subacute or chronic state. The majority of gonorrheal infections in women are, however, from the start subacute or chronic in type, and it is this larger and more usual class which is the more difficult of diagnosis and treatment. The onset may be so insidious as to deserve the title of "latent gonorrhea." These cases usually present a very typical picture if the physician is on the alert and is aware of this form.

Gonorrhea is essentially an infection which tends to remain chronic rather than to recover.

Exacerbation of symptoms after apparent cure are very frequent. These may be especially noted at the menstrual period. Again, in a case supposedly cured, an attack of grippe or any indisposition which affects the general health and brings it below par may start an acute exacerbation of symptoms.

The symptoms thus excited are usually those of urethritis, cystitis, or cervicitis. The further complications of endometritis and salpingitis are especially frequent in these chronic forms, but space will not permit the consideration of these more purely gynecologic conditions.

Joint involvement may occur with these exacerbations, and in certain cases, where the invasion has been extensive and the course protracted, the patient seems to lapse into an almost septic state. The picture of the chronic gonorrheic is pitiable indeed. There is usually loss of weight, more or less anemia, general lassitude, and mental depression. She is the victim of menstrual disorders, dysmenorrhea, menorrhagia, and a chronic leukorrhea.

The *prognosis* of a given case depends on several factors, the most

important being the virulence of the infecting gonococcus. The resistance of the tissues and the intelligence of the early treatment are also of importance.

An acute gonorrhea contracted from an acute gonorrhea is usually most resistant and chronic. But this also depends on whether the infection be a high or low one. Intelligent treatment at the onset may affect the prognosis materially. Thus, if the woman be impressed with the importance of constant conscientious treatment much may be hoped for. In cases of married women it is not enough to treat the wife: the husband must be reached in some tactful manner and put under treatment and sexual intercourse prohibited during the course of the disease.

Cases of mixed infection where (at the time of infection) the gonococcus is in a very attenuated form and the pyogenic organisms active may give at the onset the clinical picture of a most virulent gonorrhea. These cases, however, offer a good prognosis and usually make a satisfactory recovery.

Two cases which have occurred in the experience of the writer illustrate the foregoing types.

Miss L——, age eighteen, came to my office complaining of a burning discharge and painful burning micturition. On examination the vulva was found to be the seat of an intense inflammation, the hymen ruptured, and a thin, greenish pus discharge pouring down from the vagina. On further questioning, the patient admitted that she had been betrayed by her lover. A smear showed abundant gonococci. She ran a very acute course with active urethritis, cystitis, and cervicitis. Fortunately, the infection was held at the cervix and the uterus and tubes not infected. The patient has been most faithful as to treatment. One year after the first visit she had an acute appendicitis and I advised operation. At the time of the operation, on examining the uterus, tubes, and ovaries, all appeared perfectly normal. This case is still under observation and has been most resistant to treatment. She has a chronic urethritis and cervicitis, which light up with any slight indisposition. Over a number of months the symptoms are gradually improving and treatment is still continued. As far as can be ascertained, no further indiscretions have occurred.

Mrs. W——, age twenty, married six weeks: History of difficult coitus, vaginal outlet being very small, and as a result considerable trauma. Patient complained of a profuse discharge and pain in right lower abdomen. Her general condition poor, she ran a slight temperature, was pale. Examination of abdomen showed acute tenderness over McBurney's point, vaginally a violent vulvitis with a greenish thin pus pouring down from the vagina. Smears and cultures were taken for further examination. The case clinically was a virulent gonorrhea. She

was kept under observation for about twenty-four hours, during which time active douching was started; bimanual palpation failed to show any involvement of the right tube, though this could not be excluded in the presence of the vaginal discharge. Operation was advised, as the temperature and tenderness persisted. I removed an acute appendix and again found normal uterus, tubes, and ovaries. The wound was closed without drainage and healed by primary union. The vaginal condition was treated with protargol (4 per cent), and at the end of a week all active inflammation had subsided. Her recovery was uneventful. The smear and culture in this case showed a very attenuated gonococcus and staphylococci. The husband was approached and a history of a gonorrhea nine to ten years previous to marriage obtained, the husband considering himself quite well at the time of his marriage. He was referred to a genito-urinary specialist, who reported that he had a urethral stricture and pus in his urine. The husband put himself under active treatment until his urine had cleared up. The wife made a complete recovery, and a careful examination a year later failed to disclose any trace of the inflammatory process.

Curability of Gonorrhea.—Can gonorrhea be cured in women? It would seem that the consensus of opinion is that one can scarce be certain of a cure.

A certain percentage of cases of acute urethritis recover completely. When the cervix and endometrium are involved the question of a positive cure becomes more uncertain.

A large majority of these cases, after careful, persistent treatment, are apparently cured and are discharged as such. It is impossible to assure such a patient, however, that the process may not start up again at some time under various conditions.

Before discharging a woman as practically cured she should prove the following examination:

1. That leukorrhea shall have ceased.
2. That a smear and culture taken from the cervical secretion shall show no gonococci.
3. That Skene's glands shall be free from purulent discharge.
4. That Bartholin's glands and ducts shall be free of pus.
5. That the complement fixation test shall be negative.

These tests should be made on several occasions and near the time of the menstrual congestion. No douche should be taken before the examination and the patient advised to take highly seasoned food and stimulants, which may excite a latent process into activity.

PROPHYLAXIS

It would seem that a very great deal could be accomplished along prophylactic lines in handling this greatest of venereal scourges among women. The problems to be met readily fall into two classes:

1. Those for which the physician is solely responsible. Too much stress cannot be laid upon the importance of absolute asepsis in the treatment of gonorrheal cases. The physician should be scrupulously careful as to his hands, gloves, and instruments. All instruments should be boiled before and after use on a gonorrheal case. All secretions and dressings from a gonorrheal case should be properly gathered in some receptacle (a paper bag) and later burned. The utmost care should be taken in regard to the use of pessaries. No pessary which has been worn by a patient should be used by another patient. If in the adjustment of new pessaries several have been used in order to obtain a satisfactory fit, the other pessaries can be boiled (if the style permit) or thoroughly cleansed with soap and water, soaked in bichlorid (1:500) for an hour or more, and finally returned to the stock.

The lubricant used in vaginal examination may also be a source of danger—the old, uncleanly method of a stock jar of vaselin or soapsuds should be condemned and a collapsible tube or bottle used instead.

2. The second class of problems to be met is that in which the patient as well as the physician plays a part. The youth of both sexes should be instructed in the physiology of sex and the importance of personal chastity.

The growing girl and young woman should be informed of the danger of gonorrheal infection—that it may be contracted from dirty toilets, towels, douche tips, and enema outfits. Oftentimes the family physician can impart such information.

The infected woman, whether she be innocent or guilty, married or prostitute, should be warned as carefully as possible of the infectiousness of her condition. The physician who clumsily imparts such knowledge and breaks up a marriage relation is often more culpable than if he had left matters alone. All are agreed that where the harm has occurred, the added wrecking of the home is not likely to help matters.

Gonorrhea and Marriage.—It is before marriage and with a knowledge of an existing infection in either the man or the woman that the physician should speak.

This question arises much more frequently on the part of the man contemplating matrimony than the woman. Statistics state that 80 to 90 per cent of men have or have had gonorrhea, and yet of these how large a percentage marry, do not infect their wives, and have healthy

children! It would seem that the percentages of cures among men was relatively high and the sterility due to gonorrhea relatively low.

Among unmarried gonorrheic women the majority belong to the prostitute class, and this class is notoriously sterile. It is seldom, if ever, that the marriage consideration comes up with these women.

But the physician is occasionally asked to pass on the marriage eligibility of a woman who has had a gonorrhea. How shall he advise her? Ignoring the fact that public opinion says that this woman has not the same right to marriage as her gonorrheic brother, the physician must pass on each individual case as an entity.

If the woman can pass the requirements stated above the physician may assure her that she is reasonably sure of not being in an infectious state.

If she has previously had an endometritis or salpingitis, the liability of sterility on her part is very great and the physician should frankly lay this before her.

CHAPTER XVI

GONORRHEAL URETHRITIS IN THE MALE

Gonorrhea, or gonorrheal urethritis, is the most venereal of all venereal diseases, since it is the commonest malady acquired during the copulative act.

A most respectable antiquity is given to gonorrhea by the fifteenth chapter of Leviticus, although it is contended that the discharge known to the Jewish lawgiver was a simple urethritis, and that gonorrhea did not appear until later (according to Astruc in the year 1545-46).

ETIOLOGY

Gonorrheal urethritis is caused by implantation of the gonococcus upon the urethral mucous membrane. This implantation occurs almost exclusively in sexual contact. It is quite possible for the male to abstract outlying gonococci from the vulva of a timorous partner without effecting intromission (I have seen two instances of infection thus acquired). It is even possible to transmit gonococci to the urethra on the fingers. Less direct methods of contagion may be looked upon with suspicion. The mythical bathtub and the legendary privy are calculated to excite derision. However certain it be that vulvovaginitis in little girls commonly results from indirect contagion, and that infection of an adult from a drop of pus on the edge of the closet seat is perfectly possible, it is, nevertheless, singular that such a mode of infection is alleged almost exclusively by persons who are interested in concealing a transgression.

Frequently enough our patient relates that his partner was "perfectly clean." Such "perfect cleanliness" is reducible to three heads:

1. Usually the woman is supposed to be exclusively attached to someone else, who marches about in apparent health. In this case all three of the parties are undoubtedly gonorrheal, the suppliant acutely, the woman perhaps unconsciously, the accredited proprietor probably chronically. This explanation is founded upon the assumption that a woman may have gonorrhea and yet think herself clean (a matter of common knowledge), and that a man and woman, both infected, may cohabit habitually without exciting symptoms of gonorrhea in either.

I have, for example, had two persons under my care, a woman (F) and a man (M), whose history may be summarized as follows:

Spring, 1908, F infected with gonorrhea. Prompt "cure." November, 1908, F leaves her paramour and attaches herself to M. M promptly acquires gonorrhea. December, 1908, M consults me. The woman is "perfectly clean." She has acute gonorrheal arthritis. I find gonococci in M and in F. They continue to cohabit frequently. February, 1909, gonococci can no longer be found either in M or F. There have been no further symptoms of gonorrhea in either. Local treatment has been employed by both.

2. Sometimes exposure is denied on the score that the male has worn a condom. In such a case the gonococcus has been acquired during preliminary skirmishing.

3. The most difficult case to explain is that in which the woman has been examined and pronounced clean by a physician. If the male actually harbors the gonococcus and has cohabited only with one woman, sufficiently careful examination of that woman by smear and complement fixation will reveal the gonococcus.

That a woman may pass through an attack of acute gonorrhea and remain infectious, while never suspecting that she is diseased, is abundantly proven. That a male or female gonorrheic may cohabit with but one partner for many months before transmitting the infection is equally true. We scarcely need to add that of two men exposed to infection from one woman, one may acquire the disease, the other not.

PATHOLOGY

Urethral gonorrhea begins as an acute inflammation at the meatus, whence it travels inward along the urethral mucous membrane. Unless repressed by local treatment, this inflammation invariably travels as far as the bulbous urethra and usually invades the posterior urethra as well.

Although gonorrheal inflammation is essentially the same in the anterior as in the posterior urethra, we shall describe these processes separately.

The cytology of gonorrheal pus has been studied by Joseph,[1] Wile,[2] Posner,[3] Neuberger,[4] and Taylor.[5] The results obtained are nil. The predominating cell is polymorphonuclear. The eosinophil is always encountered, but does not harbor gonococci and is not pathognomonic.

[1] *Archiv f. Dermat. u. Syph.*, 1905, LXXVI, 65.
[2] *Am. Jour. Med. Sci.*, June, 1906.
[3] *Berl. klin. Wochenschr.*, November 7, 1906.
[4] *Virchow's Archiv*, 1907, CLXXXVII, No. 2.
[5] *Jour. Am. Med. Assoc.*, 1907, XLIX, 1830.

As Taylor says: "All of this detailed study of cellular elements of gonorrheal discharge, interesting as it may be, has contributed very little to our understanding of the nature, prognosis, or treatment of urethritis."

PATHOLOGY OF ACUTE ANTERIOR URETHRITIS

Onset.—The most accurate data we possess in reference to the invasion of the urethral tissues by the gonococcus are those published by Finger, Gohn, and Schlagenhaufer.[1] These authors inoculated the urethrae of criminals condemned to death, and were able, by means of immediate post mortem examination, to investigate the various stages of invasion of the tissues by the specific microbe. Thirty-eight hours after inoculation the gonococci had only just begun to effect an entrance between the epithelial cells. The lacuna of Morgagni was crowded with the cocci, diapedesis had begun, and intracellular gonococci were found among the few leukocytes on the surface of the epithelium. At the end of three days the inflammatory process was well under way. The surface of the mucous membrane was covered with pus, its epithelium infiltrated by bacteria from one side and by leukocytes from the other. The inflammation showed four striking characteristics, viz.: 1. The pavement epithelium of the fossa navicularis, although swollen with leukocytes, resisted the invasion of the gonococci almost absolutely; 2. the cylindrical epithelium of the penile urethra was generally invaded; 3. this invasion was most marked about the crypts and glands, which were packed with pus and gonococci; and 4. the subepithelial connective tissue, though showing every evidence of inflammation, contained few gonococci, except in the neighborhood of the crypts and glands.

Height.—When the inflammation reaches its height the mucous membrane, from the tumefied meatus to the bulbous urethra, is intensely inflamed. Its surface is red and swollen, covered with pus and, in places, eroded or ulcerated. The epithelia and the subepithelial connective tissue are infiltrated by the warring gonococci and leukocytes.

The glands and crypts form the most important centers of inflammation. They are implicated in the general process; inflamed and distended with gonorrheal pus. The gland orifices become obstructed by the tumefaction of the mucous membrane and the glands thus form centers whence infiltration (and even suppuration) extend into the surrounding tissues. Since the glands are numerous and extend to and, in some instances, even into the corpus spongiosum, the submucous infiltration (or suppuration) arising from them is often widespread and intense at the height of an acute gonorrhea,

[1] *Arch. f. Dermat. u. Syph.*, 1894, XXVIII, 277.

and leaves infiltrations that are the chief cause of chronic urethritis.

Were the urethra as glandless as the conjunctiva, urethral gonorrhea would show as little tendency to chronicity, complications, and systemic absorption as does conjunctival gonorrhea.

PATHOLOGY OF CHRONIC ANTERIOR URETHRITIS

As this acute inflammation subsides the tissues involved may return to a normal, or at least a clinically normal, condition, or the urethritis becomes chronic. The transformation of an acute gonorrheal anterior urethritis into a chronic condition implies certain pathologic and bacteriologic changes, as follows:

1. The inflammatory periglandular exudate becomes organized into cicatricial tissue of greater or lesser density and extent, according to the greater or lesser intensity and distribution of the acute inflammation.

2. The inflammation within the glands and crypts persists as a chronic catarrh (glandular urethritis of Oberlaender), or the orifice of the gland is occluded and the inflamed gland becomes a purulent or colloidal cyst (dry urethritis of Oberlaender), or the glandular inflammation ceases either by cicatricial obliteration or by return to normal of the gland. These changes may all occur in the same urethra. Chronic anterior urethritis is therefore denominated by the urethroscopic method in accordance with its predominant feature. The submucous glandular abscesses are minute and usually terminate by rupture within the urethra, exceptionally by invasion of the surrounding tissues and external rupture.

3. The surface of the mucous membrane is chronically inflamed. The inflammation may be localized over one or more small areas or may be general. The quality of the surface inflammation depends upon the degree of submucous sclerosis.

If the sclerosis is slight the surface is swollen, red, and eroded in spots, while here and there appear the inflamed orifices of glands and crypts. The urethroscope shows increased redness, diminution of the number of urethral striae and folds, and red, suppurating duct orifices. This is the *urethritis mucosae,* the *soft infiltration* of Oberlaender.

More marked sclerosis causes a relative anemia of the overlying mucous membrane (after the redness of acute inflammation has disappeared), which is therefore salmon colored or grayish, lighter in color than the adjacent healthy mucosa. There may be spots of opalescent whiteness, where the chronically inflamed epithelium has been transformed from a columnar to a squamous type with tendency to leukoplakia; i. e., heaping up of this squamous epithelium into thick "cal-

lous" masses. Elsewhere there may be erosions, ulcerations, papillary outgrowths. The urethroscope shows a pale rigid mucosa with striae and folds almost or quite obliterated. Here and there one sees a white patch of squamous epithelium, red gland orifices, bleeding erosions, ulcers, or papillomata. This is the *hard infiltration* of Oberlaender.

Still more marked sclerosis causes urethral *stricture*. The processes mentioned in the preceding paragraph are intensified. The rigid urethral walls do not yield to admit urethral instruments. The caliber of the urethra is more or less diminished, perhaps almost completely occluded.

Hard infiltrations of greater or less degree are classified by Oberlaender as hard infiltrations of the first, second, or third degree. Hard infiltrations of the first degree do not encroach upon the urethral caliber. Those of the second degree diminish the caliber of the urethra to such an extent that large instruments[1] can still be introduced, but only at the expense of more or less laceration of the epithelium.[2] Those of the third degree do not admit large instruments until after they have been dilated.

These more or less arbitrary subdivisions correspond to clinical types of urethritis. Yet it must not be forgotten that they are but degrees of the same process. Therefore, while the mildest form of chronic urethritis may exist alone, the more intense "hard" infiltrations are at first always accompanied by a more diffuse "soft" infiltration which may for a time conceal them.

The soft infiltration may heal spontaneously; the hard infiltration requires treatment by dilatation, and leaves a permanent scar in the walls of the canal.

4. The flora of the gonorrheal urethra undergoes a marked change as the inflammation becomes chronic (p. 166).

PATHOLOGY OF POSTERIOR URETHRITIS

The pathologic changes produced by gonorrhea in the posterior urethra are essentially the same as those produced in the anterior urethra. But certain anatomical differences vary the actual conditions. These are:

In the membranous urethra—

The relative rarity of glands.

In the prostatic urethra—

The complexity of the glands immediately beneath the mucous membrane.

The verumontanum.

[1] Oberlaender makes a urethroscopic tube of No. 23 F. size the criterion.

[2] This is the "stricture of large caliber" of the elder Otis.

The great complexity of the internal sexual glands (prostate, vesicles) emptying into the posterior urethra.

In the trigone—

The rarity and simplicity of glands.

We must, therefore, describe gonorrhea of:

1. The membranous urethra.
2. The prostatic urethra and verumontanum.
3. The prostate.
4. The seminal vesicles.
5. The trigone.
6. The vas and epididymis.

The Membranous Urethra.—The glands of the membranous urethra are relatively few and simple. Hence, chronic gonorrhea of the membranous urethra is clinically mild and is overshadowed by the inflammation of other portions of the canals. Submucous infiltrates are usually slight. Stricture is rare, chronic glandular catarrh usually mild.

The Prostatic Urethra.—The relatively large and complex glands in the mucous membrane of the posterior urethra (p. 281) and the sinus pocularis of the verumontanum form nests for possible abscess formation during acute gonorrhea of the posterior urethra, and even after the acute general inflammation has passed.

These abscesses are larger than those commonly formed in the glands of the anterior urethra. They excite fever and burst into the canal with a recognizable outpouring of pus.

Chronic Posterior Urethritis.—The urethral mucosa undergoes much the same change as those of chronic anterior urethritis. But as the inflammation grows less it may become localized in certain special forms as follows:

Villosities (improperly termed papillomata [1]) may persist in various parts of the posterior urethra. They are exuberant granulations arising from a small ulcer.

Follicular Abscesses and Cysts are rare. They usually occur beyond the verumontanum.

Verumontanitis.—The verumontanum may be regarded pathologically as a hood covering the prostatic utricle. Hence a chronically inflamed verumontanum is always associated with utriculitis, usually with vesiculitis. The urethroscope shows a swollen, red verumontanum, perhaps much hypertrophied and covered with granulations. Irrigation of the utricle usually discloses pus in its cavity; amputation of the verumontanum (Rytina [2]) shows submucous and periacinous round cell infiltration.

[1] *Surg., Gynec. and Obstet.*, 1913, XVII, 548.

[2] *Jour. A. M. A.*, 1915, LXIV, 45.

Stricture, at the bladder neck, or throughout the prostatic urethra, is rare. It is attributable to chronic sclerotic prostatitis (p. 285).

The Prostate.—The prostate is implicated in almost every inflammation of the posterior urethra. Protatitis is by far the most important complication of genital gonorrhea in the male. It is frequent, it is intractable, it is the source of many grave lesions within the prostate itself, and is a port of entry for systemic gonorrhea.

Whereas the glandular lesions of the anterior urethra are almost exclusively due to gonorrhea, the prostate may be, and often is, inflamed by other bacteria.

Three types of prostatitis are recognized: the catarrhal, the follicular, and the parenchymatous. The distinction is a clinical rather than a pathological one. In the prostate, as in the less complex glands of the anterior urethra, the inflammation is a suppuration within the gland associated with more or less surrounding infiltration, which infiltration may terminate in sclerosis or in suppuration.

Catarrhal Prostatitis.—The inflammation extends into the prostatic ducts, but spares or does not markedly involve the acini. The inflamed ducts are dilated, filled with pus and *débris*. The surrounding stroma is but little infiltrated. The examining finger detects no change in the gland, but can squeeze pus from it. The diagnosis is not made until the acute posterior urethritis has subsided, leaving the chronic catarrhal prostatic lesion.

Follicular Prostatitis.—The inflammation reaches the acini, which are distended with pus, while the surrounding stroma is infiltrated. In the acute stage the prostate is congested, tense, sensitive. As the inflammation becomes chronic the general congestion disappears, leaving the gland lumpy to the touch. The lumps are constituted by areas of diseased acini, suppurating, cystic, necrotic, or atrophic, in an indurated stroma.

Parenchymatous Prostatitis.—The follicular involvement is more intense, the interstitial inflammation more widespread and intense. *Abscess of the prostate* results. The suppuration occurs in small multiple foci, few or many, which may resolve without rupture, or coalesce to form a large prostatic abscess and rupture into the urethra or into the ischiorectal fossa, or rectum.

Chronic Prostatitis.—*Macroscopic Changes.*—To the examining finger the chronically inflamed prostate may show no change. More commonly it is enlarged. This enlargement consists of a general bulging of one or both lateral lobes or the presence of masses of induration in or about the gland.

The general enlargement of a lobe may be tense and irreducible by pressure, or it may soon yield to massage, leaving in its place a sunken pit surrounded by a more or less clearly marked rim of induration.

With this subsidence of a swollen lobe under massage there is an outpouring of purulent prostatic secretion from the meatus.

The indurations may be prostatic or periprostatic. They are irreducible by massage, but usually diminish in size or disappear after repeated massaging or even, in time, without massaging.

Microscopic Changes.—"Periacinous infiltration is so invariably present that we may speak of it as the essential lesion of chronic prostatitis. Sometimes it is combined with more extensive interstitial and endoglandular processes, but not infrequently in extensive areas the periacinous lesions may be present alone.

"The changes in the acini are manifold. In some instances the culdesacs are dilated; this dilatation . . . may be due to stricture or obstruction in the excretory ducts, but is probably more often the result of an accumulation of inflammatory products in the glandular sacs, the muscular tone of whose walls has been injured by the inflammatory process. Acini, however, the caliber of whose lumina is diminished, are almost as frequently seen as are dilated ones, and this is especially true where the prostatitis is of long standing and an extensive periacinous sclerosis has formed. At times the acini are mere vestiges or may even be entirely replaced by fibrous tissue in areas of considerable extent. The acini are often partially or entirely filled with proliferating and desquamated epithelium" (Young, Geraghty, and Stevens).

These lesions are unevenly distributed about the gland. Areas, large or small, of normal gland are usually present, and in some instances the diseased area is confined to that part of the gland adjacent to the urethra.

The dilatation of the acini may be very considerable. This dilatation is the foundation for Ciechanowski's theory of the inflammatory origin of prostatism.

Changes in the Secretion.—The normal prostatic fluid is an opalescent fluid, alkaline to litmus (and acid to phenolphthalein, whence the arguments as to its reaction). As obtained by massage, it usually contains gelatinous, transparent masses of vesicular secretion. The pure normal prostatic secretion is filled with minute lecithin bodies. It contains a moderate number of columnar and round epithelia (the nuclei of the latter almost fill the cell body), a very few leukocytes, a few corpora amylacea, and perhaps red blood cells from the trauma of massage.

The abnormal prostatic secretion is purulent. It is not so opalescent as the normal secretion. When mingled with urine (passed after massage) it often looks granular and flaky to the experienced eye. There often settles at the bottom of the glass a deposit of crumblike purulent masses (shreds). The normal elements are in inverse proportion to the amount of pus. The reaction, like that of the normal secretion, is acid or alkaline according to the reagent employed. Bacteria are sometimes present in great numbers. In rare instances pus is only obtained

after the second or third massage, the secretion expressed by the first manipulation being exclusively from the normal portions of the gland.

The diagnosis of pus in the prostatic secretion should *always* be confirmed by the microscope.

Seminal Vesicles.[1]—Seminal Vesiculitis.—The acute changes caused by gonorrhea of the seminal vesicle are similar to those in the prostate, with this exception—that the vesicle is a gland of so much larger caliber and with so much larger a duct that recognized abscess in it is uncommon, and its parenchymatous changes, if unaccompanied by dilatation, are often clinically overlooked.

Chronic Vesiculitis.—The normal vesicle is impalpable unless greatly distended with semen. Yet the vesicle, like the prostate, may be inflamed, though apparently normal to rectal touch.

The walls of the vesicle are infiltrated and matted together in what is pathologically a perivesiculitis. This may or may not result in a palpable enlargement of the gland. The mucosa is infiltrated and eroded. The lumen is in places contracted or occluded by stricture, in others dilated. This general dilatation can always be demonstrated by injection of argyrol into the vas. In long-standing cases the vesicle may be changed from its normal state—a branching ramifying canal—to an irregular cavity containing several c.c. of pus. Chronically inflamed vesicles have been appropriately termed by Belfield [2] "pus tubes in the male."

Vesiculitis is always bilateral, often impalpable.

Secretion.—The secretion of the normal vesicle varies in consistency from thick gelatinous to sticky and ropy. The microscope shows mucoidal masses entangling spermatozoa, sympexia, and epithelial cells. The color is usually opalescent, but may be rusty, especially in older persons, from pigmentation of the contained epithelia. When spermatozoa are absent Boettcher's crystals are usually found. The vesicular secretion floats (in part) in water, whereas the prostatic secretion sinks.

The secretion of an inflamed vesicle contains pus and bacteria. Live spermatozoa are sometimes, though not often, found in purulent vesicular secretion.

BACTERIA OF CHRONIC URETHRITIS

The occurrence of mixed infection in chronic urethritis is due usually to the bacteria harbored by the normal urethra, rarely to contamination by instruments. Moreover, the bacterial findings are not quite the

[1] Cf. Palozzoli, *Rev. chir. d. urol.*, 1914, Jan., Feb., Mar.

[2] *Jour. A. M. A.*, 1909, liii, 2143. Also Thomas, Ann. Surg., Sept., 1914.

same in chronic anterior urethritis and in chronic prostatitis. Hence we must consider:

The bacteria of the healthy anterior urethra;
The bacteria of chronic anterior urethritis, and
The bacteria of chronic prostatitis.

Bacteria Found in the Healthy Anterior Urethra.[1]—Pfeiffer examined 24 urethrae, and found diphtheroid bacilli in 21, streptobacillus in 10, staphylococcus pyogenes aureus in 5, micrococcus candicans in 4, sarcina alba in 14. Petit and Wassermann found 5 kinds of cocci, 6 kinds of bacilli. Franz, in 56 urethrae, found the sarcina once, the bacillus coli once, pyogenic staphylococci 6 times, streptococci twice, and 7 other varieties of cocci and 4 varieties of diplococci.

These bacteria are usually found at or near the meatus. The deeper portion of the anterior urethra is often sterile.

Bacteria of Chronic Anterior Urethritis.—Of 154 cases [2] examined 20 were sterile, 10 showed gonococci alone, 10 gonococci mixed with other bacteria, 114 other bacteria without gonococci.

Of von Hoffmann's cases, the gonococcus apart, 18 showed pseudodiphtheria bacillus, 12 streptobacillus urethrae, 2 bacillus subtilis, 3 sarcina alba, 1 proteus vulgaris, 1 bacillus coli, 1 Friedländer's bacillus. He also found 27 kinds of staphylococci, 3 other cocci, and 6 kinds of bacilli.

Bacteria of Chronic Prostatitis.—Young, Geraghty, and Stevens,[3] examined 19 cases (2 nongonorrheal) and obtained a growth on agar in only 8. The staphylococcus albus was identified thrice, the streptococcus pyogenes twice. The anterior urethra was copiously irrigated and the prostatic secretion obtained through a sterile urethroscopic tube. Control cultures were made from the bulbous urethra.

Notthaft, using less careful methods, examined 120 cases. He found the gonococcus alone in 5 cases, all within eighteen months of the time of infection; the gonococcus alone or with other bacteria in 60 per cent cases of less than eighteen months' duration, in 18 per cent cases of from eighteen to twenty-four months' duration, in 6 per cent cases of from twenty-four to thirty-six months' duration. The gonococcus was not found after the third year. The gonococcus was found 47 times, other micrococci 119 times, bacilli were found 15 times, other bacteria 14 times.

Cohn, in 12 cases, found staphylococcus albus 11 times, streptococcus 3 times, bacillus coli once, other bacteria thrice; no gonococcus.

Bacteria of Chronic Vesiculitis.—Gonococci are very rarely found in the chronically inflamed vesicle. Cultures are often sterile. The

[1] Von Hoffmann, *Centralbl. f. Harn u. Sex. Org.*, 1904, xv, 569.
[2] Reported by Tano, Cohn, Owens and von Hoffmann.
[3] Johns Hopkins Hospital Reports, 1906, xiii, 276.

flora includes staphylococcus, streptococcus, bac. lactis aerogenes, and bac. coli.

Summary.—Thus the gonococci that swarm in the discharges of acute gonorrhea are by no means always present in chronic gonorrheal urethritis and prostatitis. Notthaft [1] quotes in favor of his thesis that they disappear from the prostate always within three years, often within eighteen months, the names of Neisser, Finger, Frank, Wassidlo, Jadassohn, Goldberger, and others. The thesis may, I believe, be extended to include all the urethral glands. I have seen but one apparently authentic case in which gonococci persisted for three years in the urethral secretion; not more than three or four in which, in spite of vigorous treatment, they persisted for over two years. Earnest investigation during the past three years, with the aid of the complement deviation test, has served only to confirm this belief. The rule is almost without exception that a chronic gonococcic urethritis ceases to show gonococci in its secretion within three to six months of the beginning of intelligent local treatment.

[1] *Archiv f. Derm. u. Syph.*, 1904.

CHAPTER XVII

SYMPTOMS, COURSE, AND COMPLICATIONS OF ACUTE URETHRAL GONORRHEA IN THE MALE

Since acute gonorrhea of the male urethra always begins with inflammation of the balanitic urethra,[1] continues by direct extension of the inflammation along the urethral mucous membrane, and may terminate before the inflammation reaches the posterior urethra, to be accurate we should speak of anterior urethritis alone as essential gonorrheal urethritis and class all other gonorrheal inflammations, including posterior urethritis, as complications. But inasmuch as the average uncontrolled urethral gonorrhea invades the posterior urethra, the trigone, and the prostate, it is clinically convenient to group anterior urethritis, posterior urethritis, and prostatitis in the type description of the disease and to follow with a description of other inflammations as complications. Accordingly, we shall describe:

The incubation.

Typical acute gonorrheal urethritis.

Atypical acute gonorrheal urethritis.

- Prolonged or complicated cases.
- Mild cases.
- Severe cases.
- Cases modified by treatment.

Complications of acute anterior urethritis.

- Abscess of the urethral glands.
- Periurethritis and periurethral abscess.
- Inflammation of the erectile tissues.
- Balanoposthitis, lymphangitis, lymphadenitis.

Complications of acute posterior urethritis.

- Prostatitis.
- Prostatic abscess.
- Seminal vesiculitis and deferentitis.
- Epididymitis.
- Cystitis.
- Pyelonephritis.
- Peritonitis.

[1] Excepting cases of reinfection of the urethra from gonococci that have lain quiescent in the urethral glands, which cases are properly classed as relapses.

INCUBATION OF GONORRHEAL URETHRITIS

The incubation period of gonorrhea varies from two to seven days. The earlier authors recognized longer incubation periods. Yet I confess to some suspicion of inaccuracy in reference to those cases on the subjoined list that give a story of more than a week's incubation. Perhaps some of them had very long foreskins.

Experimental inoculation produces a discharge on the second, third, fourth, or fifth day; but it has been my experience that the shorter incubations are clinically due to the association of sexual strain or of simple urethritis with the gonococcus. Such a condition may be expected to occur most often in the damaged urethra of the *roué;* hence the relatively large number of short incubations among recurrences as compared with first attacks.

Length of Incubation[1]

Day.	First Attack.	Recurrence.
1	0	2 cases.
2	2 cases.	12 "
3	2 "	15 "
4	3 "	13 "
5	11 "	10 "
6	6 "	4 "
7	4 "	10 "
8	1 case.	2 "
9	1 "	1 case.
10	1 "	4 cases.
11	1 "	1 case.
12	1 "	0
13	1 "	0
14	0	2 cases.
Total	34	76

Average incubation of 34 primary attacks, 6 days.

Average incubation of 76 secondary attacks, 4.88 days.

Of the primary attacks, 20 per cent appeared before the fifth day; 61 per cent on the fifth, sixth, and seventh.

Of the secondary attacks, 55 per cent appeared before the fifth day; 31 per cent on the fifth, sixth, and seventh.

TYPICAL ACUTE GONORRHEAL URETHRITIS

Onset.—A tickling, teasing, itchy irritation is felt at the orifice of the urethra. The lips of the meatus are found adherent, or a bluish,

[1] I have included in this list only those cases in which the incubation period was unmistakable and the disease absolutely characteristic—microscopically, clinically, or both.

sticky discharge is seen between them. A slight stinging is felt on urination. The lips of the meatus now swell slightly and redden. The quantity of discharge increases and it becomes frankly purulent. The meatus feels hot and sore. The pain on urination increases.

Height.—In a period varying from a few hours to two or three days the inflammation reaches its height at the meatus and has invaded the greater part of the anterior urethra. The symptoms of anterior urethritis are swelling of the meatus, purulent discharge, painful urination, and painful erections.

The Swollen Meatus.—The lips of the meatus are red, swollen, everted, sometimes eroded. Their tumefaction is almost pathognomonic of gonorrhea. It begins with the disease and usually subsides during the second or third week, long before the subsidence of the inflammation of the deeper portion of the urethra. It is less constant and less marked with secondary than with primary attacks.

The Discharge.—The drop of thick greenish-yellow pus constantly exuding from the swollen meatus completes the outward picture of acute gonorrhea. Blood may appear in the discharge from time to time. The pus ceases to be thick and creamy some time after the swelling of the meatus has subsided. It becomes less in quantity and more watery and opalescent in quality as the acute inflammation of the anterior urethra declines.

The Pain on Urination.—The urethral mucous membrane is swollen, sensitive, and eroded. Hence, the passage of urine is painful, the stream slow and obstructed.

The pain due to anterior urethritis reaches its height within ten to fourteen days and begins to subside between the fourteenth and the twenty-fifth day.

The Painful Erections.—The urethral inflammation encourages nocturnal erections. The inflamed membrane is relatively inelastic, hence these erections are exceedingly painful. The inflamed surface may be so cracked and fissured that it bleeds copiously. Since the corpora cavernosa retain their normal distensibility, the inelastic, inflamed urethra is pulled taut beneath them when the penis is erect, so that in severe cases the organ is bent downward, while the pain is excruciating. This phenomenon is called *chordee*.

Painful erections may continue for days after the surface of the anterior urethra has ceased to be sensitive to the passage of urine.

Invasion of the Posterior Urethra and Prostate.—It is clinically impossible to distinguish acute posterior urethritis from acute prostatitis, and although in some instances the posterior urethra is involved and the prostate apparently spared, this cannot be determined until after the disease has become chronic.

The frequency of posterior urethritis in acute gonorrhea is esti-

mated variously. Van der Poel estimates it at 60 per cent, Wassidlo quotes various authors at from 86 per cent to 92 per cent. Prostatitis is estimated to complicate about 70 per cent to 80 per cent of acute posterior urethritis, though Columbini places it as low as 36 per cent.

The confusion in these figures is due to the various means of examination employed. Subjective symptoms of posterior urethritis are excited by the majority of initial gonorrheas, are less common in subsequent attacks, and are rare in office patients treated by repressive measures. On the other hand, if pus in the second flow of urine is taken as a criterion, the percentages run much higher. Let us be satisfied to say that acute posterior urethritis is extremely common and usually associated with prostatitis.

Posterior urethritis usually appears between the fifth and the fifteenth day of acute gonorrhea.

Symptomless Cases.—The figures given in the preceding paragraph illustrate the frequency with which gonorrhea invades the posterior urethra without causing subjective symptoms.

The evidence of this invasion is pus in the second flow of urine or palpable enlargement of the prostate.

It is probable that in these symptomless cases the prostatic urethra is only mildly inflamed, the trigone spared altogether.

Symptoms of Acute Posterior Urethritis and Trigonitis (Cystitis).—The symptoms of acute gonorrheal posterior urethritis, trigonitis, or cystitis are all referable to the irritation at the bladder neck. This causes frequent and urgent urination, painful urination, and terminal hematuria.

Frequent and Urgent Urination.—So long as the pain of urination is due solely to anterior urethritis the patient urinates as rarely as possible. When it is due to posterior urethritis he *must* urinate frequently. As soon as a relatively small amount of urine has collected in the bladder an urgent call to urinate is felt; a call that will not be denied. If the victim does not quickly acquiesce he irrigates his trouser leg. The frequency of this urgent call may be so great that the patient dribbles away a few drops of purulent urine every ten or fifteen minutes night and day. A frequency of less than once in two hours may be accounted mild.

Painful Urination.—The pain of posterior urethritis is more constant than that of anterior urethritis, and is often referred to some point on the surface of the body, usually the perineum, the anterior urethra just back of the glans, or the epigastrium.

The pain at urination in posterior urethritis has several striking characteristics. It appears before urination, as we have just seen, in the form of urgency. During urination the posterior urethra can be more exquisitely sensitive than the anterior urethra. But it is at the

end of urination that the full force of this pain is felt. As the muscles of bladder and urethra contract to expel the last drops of urine the inflamed surface is violently wrenched. The resultant pain, like that of anal fissure, is a spasm or series of spasms that may last for many seconds after the bladder has emptied itself. In severe cases the patient may be said to pass from one terminal urinary spasm to another.

Terminal Hematuria.—The intensity of the inflammation, together with the incessant trauma of the frequent urination, often excite bleeding from the posterior urethra. This bleeding may be constant or intermittent. In either case the amount of blood lost is not great, and the three-glass test reveals terminal hematuria; i.e., whether the body of the urine be bloody or not, the last jet is almost pure blood. Terminal hematuria is caused by terminal spasm.

The Decline.—The inflammation subsides first where it first began, i. e., at the meatus. The meatal inflammation often disappears in the second or third week, while the inflammation is elsewhere at its height. In the rest of the anterior urethra the inflammation usually begins to decline in the third or fourth week; the discharge becomes thinner and more watery, the erections less painful. The pain, frequency, and bleeding that mark posterior urethritis may begin to diminish at almost the same time.

In the fourth or fifth week the patient's symptoms are reduced to a semipurulent discharge, which grows less and less in quantity. From the sixth to the eighth week this discharge usually continues almost or quite exclusively as "a morning drop," a drop of pus appearing at the meatus only before the first morning urination; during the rest of the day the urethra is apparently clean. Now the patient fancies himself well. But examination of the urine still reveals pus; examination of this pus still reveals gonococci.

It is rare for the gonococci and pus to disappear within six weeks. It is common for them to persist eight to twelve weeks.

By common consent the gonorrheal urethritis of less than two months' duration is called acute, of more than three months' duration chronic. The division is purely arbitrary, but it voices the fact that acute gonorrhea is often cured in from eight to twelve weeks.

ATYPICAL ACUTE GONORRHEAL URETHRITIS

The good or evil fortune of the patient in his choice of a physician as well as in his reaction to the disease so influences the course of each individual case of gonorrhea that the attempt to separate "typical" from "atypical" cases, though justified by expediency, has no foundation in clinical fact. The above description of a "typical acute gon-

orrheal urethritis" describes many cases in general but none in particular. Every case is actually "atypical" to a greater or less degree.

Prolonged or Complicated Cases.—What proportion of gonorrheics become chronic I do not know. In the clinic most cases approach the three-months' limit and perhaps half surpass it. In private practice, by the aid of repressive measures, we get better results.

But practically every unrepressed case of gonorrhea is a "complicated" case. Some one of the complications mentioned below almost invariably arises unless repressive measures are employed.

Mild Cases.—The initial gonorrhea is quite invariably severe. Subsequent infections, especially if often repeated, may run a much milder course; so mild, indeed, that it might be quite impossible to determine when a given patient was last infected. The bearing of this fact upon the alleged persistence of gonococci in urethral pus for many years in exceptional instances is most important.

Reinfections may excite merely a slight mucopurulent discharge with the least possible subjective irritation. The acute attack may last but a week or so. Yet from such an infection gonococci may persist in the urethra quite as long as though the attack had been most severe. Moreover, the urethra thus inflamed may resent instrumental or other traumata, though the reaction to these is not so fierce as when the urethral inflammation is more intense.

Acute Reinfections.—Sharp, short reinfections of the anterior urethra, with copious creamy discharge, yet lasting but a few hours or a few days, are more often due to reinfection from the patient's own secretions (occasioned by instrumentation, sexual or alcoholic excess, spontaneous rupture of follicular abscess, etc.) than to fresh infection acquired from without. The striking feature of such reinfections is their brevity: the contrast between the profuse, creamy, gonococcus-laden discharge of today and the entire absence of all symptoms tomorrow.

Severe Cases.—Urethral gonorrhea may be severe in its onset (prompt involvement of posterior urethra or epididymis, early appearance of complications, intensity of subjective symptoms), in its complications, or in the severity or duration of its acute symptoms.

Thus chordee, or the pain and frequency of posterior urethritis, may be almost or quite the first symptoms complained of; epididymitis, even, may apparently begin the attack. Yet, unless they be autoreinfections, it is not correct to classify such outbreaks as beginning in the posterior urethra or in the epididymis.

The prolongation of intense chordee or posterior urethritis through many weeks occurs just often enough to remind us of the total lawlessness of gonorrheal inflammations.

Cases Modified by Treatment.—The local treatment now almost

universally employed throughout acute gonorrhea always materially modifies the course of the disease. If successful it ameliorates all the symptoms and minimizes the danger of complications; if unsuccessful, it intensifies the urethral inflammation, excites complications, or encourages chronicity.

COMPLICATIONS OF ACUTE ANTERIOR URETHRITIS

Abscess of the Urethral Glands.—Minute abscesses due to obstruction of the ducts of suppurating glands doubtless occur and pass unnoticed amidst the intense symptoms of every acute urethral gonorrhea. Such abscesses occurring during the declining stage cause a characteristic brief explosion of acute symptoms. After a day or more of vague localized uneasiness or itching a sharp reinfection of the urethra occurs. The discharge becomes profuse and creamy; the meatus may even swell, but there is usually no pain. But no sooner has the patient decided that he must look forward to weeks more of suffering than the discharge abates almost as suddenly as it appeared.

This sudden abatement of discharge is doubtless due to local immunity persisting from the preceding acute urethritis. It is exceptional for this immunity to be so slight as to permit prolonged relapse.

Periurethritis and Periurethral Abscess.—Extension of suppuration from an infected urethral gland to the periurethral connective tissue is to be expected only as a result of overtreatment or of scars left by antecedent gonorrheas.

The suppuration arises from the balanitic, the pendulous, or the bulboperineal portions of the anterior urethra.

Abscesses arising from the balanitic portion of the canal appear at one or both sides of the preputial frenum. They grow rapidly and, having opened or been incised, often leave permanent fistulae requiring a special procedure for their cure.

Abscess of the pendulous urethra usually projects from the floor of the canal as a hard nodule. It may grow quite slowly and may resolve or break into the urethra. But it is far more likely to invade the skin and point directly opposite to its point of origin, or to travel beneath the fascia for a considerable distance before discharging externally, unless its course is cut short by incision. The fistula heals spontaneously.

Abscess of the perineal urethra is usually spoken of as *abscess of Cowper's gland,* though it is impossible to say in what proportion of cases this gland is actually the one involved. The inflammatory mass often appears to one side of the median line and usually travels to a distance beneath the deep fascia before breaking through this, thus causing extensive perineal infiltration, if not promptly incised.

All of these processes travel forward, so that, while abscess originating in the pendulous urethra never points in the perineum, perineal abscess may show itself prominently only about the pendulous urethra. The attachment of the deep fascia to the anterior layer of the triangular ligament prevents extension of perineal suppuration backward.

Inflammation of the Erectile Tissues.—*Spongeitis and cavernitis* are extremely rare complications of gonorrhea, if we except that type of the former that manifests itself in chordee.

Thrombophlebitis of the erectile tissues or inflammation of the fibrous envelopes manifest themselves as sensitive indurations of the erectile bodies. Under appropriate treatment they usually resolve, but they may suppurate and require incision.

Balanoposthitis.—The gonorrheic with a long or tight foreskin usually develops balanoposthitis in spite of all his care. Yet the complication is rarely severe. It has no peculiar characteristics, is apparently due to mixed infection, and readily yields to the usual treatment.

Lymphangitis and Lymphadenitis.—These complications are rare, inasmuch as they are due to extension of the gonorrhea beyond the urethra proper. They result usually from balanitis, less often from periurethritis, and, like the balanitis of gonorrhea, are not specific and are rarely severe. I have seen but one gonorrheal bubo that required incision.

COMPLICATIONS OF ACUTE POSTERIOR URETHRITIS

Prostatitis.—Any inflammation of the prostate short of abscess adds scarcely any symptoms to those of the urethritis. Mild prostatitis, like mild posterior urethritis, may give no sign of its presence, while a more intense prostatitis, accompanying posterior urethritis, does not alter the clinical picture already described. The involvement of the prostate may or may not be distinguishable by rectal touch.

Prostatic Abscess.—In drawing an arbitrary division between acute prostatitis and prostatic abscess, it is wiser to include with the latter all cases of acute prostatitis of sufficient severity to cause symptoms. This for two reasons: all such cases do represent retention of pus within the prostate ducts, and any one of them may progress to unmistakable abscess formation.

To attempt to draw the line between the prostate in which macroscopic suppuration (abscess) has already occurred, and that in which it only threatens, is impracticable.

Symptoms.—The symptoms of prostatic abscess follow one of three types, as follows:

The *local symptoms are accentuated.* To the pain and frequency of

urination due to posterior urethritis is added a constant dull or throbbing ache inside the pelvis, which may or may not radiate to the urethra, the testicles, the thighs, the hypogastrium, or the loin. If the prostate is much enlarged defecation is apt to be both painful and difficult.

Fever, often severe, and ushered in by a chill, is added to the afebrile urethral inflammation. But fever is no criterion of the extent or progress of the prostatic involvement. Absence of fever is often noted in extensive prostatic suppuration.[1]

Retention of urine is a marked feature in many cases. Partial retention escapes observation; but acute, complete retention, requiring relief by the catheter, may occur. I have relieved by operation gonorrheal abscess in both lobes of the prostate, the only symptom of which was acute retention of urine, preceded by no dysuria and accompanied by no fever.

Yet in some instances dysuria, fever, and retention occur simultaneously.

Physical Signs.—The suppurating prostate is always enlarged, usually sensitive. The whole of one or both lobes is involved. The diagnosis should be made long before either boggy softening or fluctuation shows that the whole of a lobe has been transformed into an abscess cavity.

Course.—The process may terminate by resolution; by rupture into the periprostatic tissue, causing ischiorectal abscess, or into the urethra, or the adherent rectum, or by passing on to chronic prostatitis.

Alexander [2] studied 68 cases of gonorrheal prostatic abscess. Of these 31 appeared during the first gonorrhea, 37 during relapses; 35 caused retention of urine; 22 had burst—into the perineum (16), the ischiorectal fossa (5), the rectum (1). The abscess was complicated by urethral stricture 9 times.

If the pus burrows forward into the perineum it may occasion considerable mischief, burrowing along toward the corpus cavernosum, or even laying it bare. It has been known to go through the obturator foramen (Tillaux), and even to follow the connective-tissue plane about the spermatic cord and to point in the inguinal canal, or to get into the space of Retzius, to appear at the umbilicus, to pass by the sciatic notch (Guyon)—all very rare, but still possible culminations of neglected periprostatic suppuration.

Seminal Vesiculitis.—Acute seminal vesiculitis, like acute prostatitis, usually gives no sign of its presence. If suppuration occurs in the vesicle the symptoms are those of prostatic suppuration, but a finger in the rectum discloses a tense, sausagelike tumor in the region of the

[1] Keyes, *New York Polyclinic Journal,* 1908, xii, Nos. 9 and 10.

[2] *Ann. of Surg.,* 1903, xlix, 533, 563.

inflamed vesicle. It usually terminates in resolution, but may rupture into the ischiorectal fossa, the rectum, or the peritoneum.

Vesiculitis does not occur without prostatitis. It is impossible to differentiate inflammation of the ampulla of the vas from vesiculitis.

Epididymitis.—*See* Chapter LIX.

Cystitis.—The familiar gonorrheal trigonitis already described implies some inflammation of the rest of the bladder, but this is not a clinical feature of gonorrhea.

Pyelonephritis.—This is an extremely rare complication of gonorrhea. It is best described in connection with other types of pyelonephritis.

Peritonitis.—Pelvic peritonitis is as rare a complication of gonorrhea in the male as it is common in the female. Battey [1] has collected 30 cases. Thomas [2] reports 2 more. The inflammation is due to vesiculitis or deferentitis. Its symptoms are the classic ones of pelvic peritonitis.

[1] *Thèse de Lyon*, 1901; *Brit. Med. Jour.*, April 5, 1902.

[2] *North Western Medicine*, February, 1907.

CHAPTER XVIII

COURSE AND COMPLICATIONS OF CHRONIC URETHRAL GONORRHEA

Chronic gonorrhea is gonorrhea lasting more than three months. The term is arbitrary and by no means strictly accurate, for chronic gonorrhea may be interrupted by acute relapses of the disease without thereby ceasing to be chronic, and chronic gonorrhea may begin and end, from the clinical as well as from the pathological standpoint, within the two months usually allotted to acute gonorrhea.

Course.—Gonorrhea becomes chronic because the urethral lesions caused by the gonococcus persist. These lesions may harbor the gonococcus alone, or in connection with other bacteria, or simply other bacteria without the gonococcus. They may involve the anterior or the posterior urethra or both. Chronic gonorrhea is therefore to be subdivided either as gonococcic and postgonococcic or as chronic anterior urethritis and chronic posterior urethritis.

The clinical causes of chronic gonorrhea are not worth enumerating in detail. Any interference with the proper treatment of acute gonorrhea may permit it to become chronic; in some instances it becomes chronic in spite of the best treatment.

Varieties.—Study of the flora of chronic gonorrhea (p. 166) shows the rapidly decreasing importance of the gonococcus and the rapidly increasing importance of mixed infection after the third month of the disease. No further subdivision is possible; apart from the gonococcus no bacterium has shown itself peculiarly virulent in the male urethra. Nongonococcic urethritis is usually postgonorrheal.

Gonococcic chronic urethritis is distinguished clinically by a tendency to be more severe, to relapse more viciously, to resent the trauma of instrumentation and alcohol more sharply than does nongonococcic urethritis. Yet these clinical distinctions are both vague and relative. They have meaning only to the expert. A specific urethritis may be latent for months, a nonspecific one may be peculiarly virulent.

To distinguish the symptoms of chronic anterior urethritis from those of chronic posterior urethritis is a necessity, but clinically the two usually exist together, the one or the other predominating.

SYMPTOMS AND COURSE OF CHRONIC ANTERIOR URETHRITIS

The one subjective symptom of chronic anterior urethritis is a *urethral discharge,* greater or less in quantity, purulent, semipurulent, or sticky and mucoidal. Sensations of itching or pain almost invariably arise from posterior urethritis and its complications, even when the sensation appears to be situated in the anterior urethra.

But, since this urethral discharge is but the evidence of an overflow of pus, the flow may be intermittent and months, even years, may elapse while an anterior urethritis continues but gives no outward sign; but produces only a little pus or a few shreds in the urine.

The *course* of a chronic anterior urethritis may be interrupted by outbreaks of acute infection, either a relapse or a new gonorrheal infection. Such outbreaks are usually much less severe than the initial attack.

The only *complication* of chronic anterior urethritis other than those mentioned in the last chapter is urethral stricture.

Abscess of the urethral glands may remain as little suppurating pouches. These may (1) simply maintain the infection, or (2) be palpable as shotty indurations, which (3) may at any time become acutely inflamed and tender and even (4) set up periurethral abscess.

The *urinary signs* of chronic anterior urethritis are a major element in diagnosis (p. 195).

SYMPTOMS OF CHRONIC POSTERIOR URETHRITIS AND PROSTATITIS

Chronic posterior urethritis and chronic prostatitis can rarely be distinguished from each other. Indeed, chronic posterior urethritis is clinically synonymous with chronic follicular prostatitis. On the other hand, chronic prostatitis may not be complicated by chronic urethritis [1] (30 per cent of 280 cases studied by Young).

Hence it is preferable to consider chronic posterior urethritis under the title of chronic prostatitis.

The symptoms of chronic prostatitis are much the same whether caused by the gonococcus or not. If gonococcic, the inflammation is more likely, either spontaneously or as the result of massage or urethral instrumentation, to light up an acute urethritis, while nongonococcic (or postgonococcic) cases sometimes flare up in the shape of vesical bacteriuria.

[1] I. e., the prostate may contain pus but the urine be free from pus and shreds.

Hence it is clinically preferable to group all cases of chronic prostatitis, whether gonorrheal or not, under one head.

"In our series of 358 cases, no etiology was obtained in 53 cases (14.8 per cent); there was a history of gonorrheal urethritis in 262 (73.2 per cent); of masturbation in 27 (7.5 per cent); of prolonged sexual excitement (without coitus) in 4 cases and withdrawal in 3 cases (2 per cent); of descending infection in 3 (0.8 per cent); of traumatism (bicycling twice) in 3 (0.8 per cent); of instrumentation in 2 (0.6 per cent); of infectious diseases (grippe) in 1 case (0.3 per cent). When gonorrhea had existed, that was accepted as the cause of the prostatitis, although in some of these cases abnormal sexual practices may have played an important rôle" (Young, Geraghty, and Stevens).

The symptoms of chronic prostatitis are classed by Young as urinary, referred, and sexual.[1]

The urinary symptoms are:
- Urethral discharge.
- Disturbance of urination.
- Mechanical obstruction to urination.

The referred symptoms are:
- Reflex pains and abnormal sensations.

The sexual symptoms are:
- Disturbance of the sexual function.
- Spermatorrhea and prostatorrhea.

Urethral Discharge.—Urethral discharge is a symptom of anterior urethritis. Yet persistent urethral discharge is the symptom that usually brings the victim of chronic prostatitis to the physician. Moreover, such urethral discharge can be cured only by treatment of the prostate. In the average case, therefore, chronic prostatitis is accompanied not only by posterior urethritis, but by anterior urethritis as well.

Disturbance of Urination.—Urination may be normal, frequent, painful (before or during the act), urgent, or difficult. The stream may be slow to start or slow to terminate.

None of these symptoms is absolutely characteristic of prostatitis, nor can one infer the pathological process present from a consideration of them.

Obstruction to Urination.—Obstruction to urination, though a rare result of chronic prostatitis, may, nevertheless, be the most important feature of a given case. The obstruction is due either to an enlarge-

[1] In their study of chronic prostatitis, Young, Geraghty, and Stevens have attributed to this malady certain symptoms (e. g., renal colic and pain in the rectum) characteristic of vesiculitis. For this reason the detail of symptoms given by them has not been precisely followed.

ment of the median isthmus in the form of a bar or to cicatricial contraction of the vesico-urethral orifice, i.e., stricture (contracture) of the neck of the bladder. The symptoms are those of prostatism, occurring in a young person. The prostate is usually not enlarged, as felt from the rectum (p. 289).

Reflex Pains and Abnormal Sensations.—The abnormal sensation excited by chronic prostatitis may be a pain, an itching or burning sensation, or a sense of fullness. It may be constant or intermittent; it is rarely very severe. It may or may not be excited by a full bladder or by the passage of urine. The majority of patients with chronic prostatitis suffer little or no discomfort.

The abnormal sensation is always referred to some point on the surface of the body. The sensation may be felt at any point below the navel, even as far away as the foot. But the characteristic pains of prostatitis are pain in the back, in the perineum, above the pubes, along the urethra, in the groin or testis. Certain of these pains merit a word of description.

Pain in the Back.—The pain is usually in the upper sacral region, constant and aching in character, uninfluenced by urination. Pain over the kidneys is rare.

Pain in the Perineum.—The perineal pain is usually so mild as to be little more than a sensation. It may or may not be influenced by urination. It is often associated with a peculiar sense of fullness in the perineal body, or with a peculiar irritability in that region, excited by continued pressure against the perineum. The patient who suffers from this symptom cannot sit still for any length of time, though, as a rule, he prefers a hard seat to a soft one. He is debarred from the theater and the church, and on the railroad he either sits obliquely on one hip or paces the aisle.

Pain Along the Urethra.—Two spots along the penile urethra are especially subject to referred prostatic sensations. These are (1) a point just behind the glans penis and (2) the penoscrotal angle. Many patients are obsessed with the belief that all their trouble lies in one or other of these spots, whereas the sensation there is a characteristic sign of trouble in the deep urethra and prostate.

Disturbance of the Sexual Function.—Premature and painful ejaculations, incomplete or painful erections, nocturnal emissions, and every other symptom of sexual neurasthenia occur in persons whose prostatic fluid contains more or less pus. They are sensory disturbances, due to pathological changes in the *verumontanum*, the utricle or the ejaculatory ducts. These symptoms are rare in patients with severe prostatitis. They are fully as common in patients who have not had gonorrhea as in those who have.

Prostatorrhea and Spermatorrhea.—Like the functional disturb-

ance noted in the preceding paragraphs, prostatorrhea and urethrorrhea are usually functional sexual disturbances only accidentally post-gonorrheal (cf. p. 188).

Symptomless Cases.—It is not to be forgotten that many cases of chronic prostatitis produce no symptoms.

SYMPTOMS OF CHRONIC VESICULITIS

Chronic inflammation of the seminal vesicle is always associated with chronic prostatitis. In the clinical picture either inflammation may predominate.

Neuralgia of the Testis and Cord.—Neuralgia of the testis and spermatic cord, whether dependent upon ungratified sexual excitement or not, is very commonly due to spermatocystitis, rarely to prostatitis.

Chronic vesiculitis exhibits the following clinical types:

Renal Colic.—Renal colic may be caused by vesiculitis but not by prostatitis. I have seen several instances of this condition typical in every respect of a renal colic due to stone and requiring morphin for their relief. Yet in each instance the vesicle was manifestly diseased, pressure upon it elicited the pain, and massage relieved it.

Rectal Pain.—A much more common and equally characteristic symptom of vesiculitis is pain in the rectum. It is felt in the region of the vesicle, high up in the rectum. It is usually intermittent, excited by defecation, erection, or ejaculation, or it occurs spontaneously. The spontaneous pain usually occurs at night quite independently of any sexual irritation. It is griping in character, lasts only a few minutes, recurs at irregular intervals, and has been appropriately termed *vesicular colic.*

Frequent Urination.—Adhesion of the chronically inflamed vesicle to the bladder wall may exceptionally cause frequent and painful urination.

Painful Testicle.—This is usually a reflex pain from the corresponding vesicle (p. 590).

Relapsing Epididymitis.—This is doubtless due, as Belfield has suggested, to occlusion of the ejaculatory duct, with chronic suppuration both in the vesicle and in the epididymis (p. 570).

Sexual Symptoms.—Those symptoms, enumerated in the preceding section, are due to inflammation in the region of the verumontanum. They are allied much more closely to inflammation of the vesicle than to that of the prostate.

Gonorrheal Rheumatism.—The importance of seminal vesiculitis in the etiology of gonorrheal rheumatism has already been alluded to.

Fuller first suggested that gonorrheal rheumatism is due to chronic

seminal vesiculitis. Ample confirmation is afforded by the observations of Squier, Young and others. But the mathematical relation has not been established. The great majority of inflamed vesicles result in no septic arthritis or other symptoms of absorption. Moreover a large minority of gonorrheal joints are not cured even by vesiculectomy (Cabot). Yet in many instances vesiculotomy unquestionably results in relief of the joint pains.

Symptomless Cases.—So long as the vesicle is not distended, and the ejaculatory duct not obstructed, the mere presence of chronic inflammation in the organ usually excites no symptoms.

CLINICAL VARIETIES OF CHRONIC URETHRITIS

The preceding array of symptoms fails to give a picture of chronic gonorrhea. To obtain this we must sum up the clinical types of the disease in a few brief paragraphs.

All cases of chronic urethritis may be classed as follows:

1. Mild cases.
2. Intractable cases.
3. Relapsing cases.
4. Irritable cases.
5. Neurotic cases.

1. **Mild Cases.**
2. **Intractable Cases.**

—Although most chronic inflammations of the urethra are mild in their symptoms, few of them are mild in responding promptly to treatment.

A slight discharge is all that marks the usual case. Yet this discharge may be utterly intractable. Rapidly curable cases are usually those in which the prostate is neither markedly inflamed nor hypertrophied, the inflammation postgonococcic, the patient tractable and in good surroundings and health. Conversely, any complication, especially severe prostatitis, the presence of gonococci, or bad general conditions are inimical to a cure.

3. **Relapsing Cases.**—Every case of chronic urethritis has some tendency to relapse after a cure has apparently been effected. But certain urethrae show a tendency in this respect little less than maddening. Perhaps the patient has been carried successfully through an acute gonorrhea by repressive treatment when an unexpected outbreak of the disease disappoints surgeon and patient alike. Or a chronic case may have gradually yielded to methodical treatment only to burst out afresh at the slightest provocation. It is absolutely essential to know, before pronouncing a patient cured, that his urethra and prostate no longer

harbor gonococci. This fact ascertained, we may at least assure him against severe or infectious relapses.

The cause of relapse is a collection of pus in some gland or follicle. Its occasion may be alcohol, sexual excess, a cold in the head, or over-zealous local treatment.

4. **Irritable Cases.**—The irritability of some urethrae is such as to prohibit local treatment, whether because of the pain and spasm evoked, or because an outburst of acute inflammation in the urethra, the prostate, the vesicle, or the epididymis follows every instrumentation. This local irritability, while in a sense peculiar to the individual, is usually the result of habitual disregard of the rules of prudence. The patient is either a hard drinker, or addicted to sexual excess, or overworked and overworried, or—and this alternative is, unfortunately, not a rare one—he has been irritated by local treatment. An appreciation of this fact will help to direct the treatment of such cases.

5. **Neurotic Cases.**—The neuroses are not always due to antecedent gonorrhea, and it is only exceptionally that one encounters evidence of neurosis while the inflammation still continues. The neurotic taint adds many and various symptoms to those of the inflammation, and protracts the patient's miseries even after his prostate has apparently returned to its normal state. But most of the so-called neuroses are due to the inflammation about the verumontanum.

CHAPTER XIX

NONGONORRHEAL URETHRITIS

Nongonorrheal urethritis as distinguished from postgonorrheal urethritis may be classified as follows:

Nonspecific or "simple" urethritis.
Tuberculous urethritis (p. 433).
Traumatic urethritis.
Neoplastic urethritis.
Syphilitic urethritis.
Herpetic and eczematous urethritis.
Urethrorrhea.
Prostatorrhea.
Spermatorrhea.

NONSPECIFIC URETHRITIS

Nonspecific urethritis may be defined as an acute urethritis due neither to the gonococcus nor to the tubercle bacillus, and usually excited by no known cause other than sexual excitement or contact.

Under this caption we may also include the so-called *urethritis ab ingestis,* and diathetic urethritis, neither of which seems to occur in virgin urethrae.

Urethritis ab Ingestis.—Certain substances taken into the stomach may occasionally produce a mild urethritis. Among these alcohol holds a high rank. Excessive potations, notably of beer or champagne, or prolonged excesses of alcohol in any form, will occasionally, without other cause, produce urethral discharge. As an adjuvant to sexual excess the influence of alcohol is paramount, more particularly if there be already a preëxisting patch of chronic inflammation anywhere along the urethra. Cantharides, arsenic, purgative mineral waters, iodid of potassium, turpentine, asparagus, have all been accused of lighting up mild urethral inflammation, but the rarity of such attacks makes their consideration trivial.

Diathetic Urethritis.—A gouty urethritis is accepted in England and a strumous urethritis has been mentioned; but as essential maladies both are a refinement of diagnosis. The gouty old gentleman

with densely acid urine is more liable to discharge because of his gout, and treatment of the latter may be essential to his recovery.

There are also well-observed instances of the appearance of a discharge from the urethra upon the subsidence of an arthritic eruption upon the skin, and Desnos alludes to the sudden appearance of a spontaneous urethral discharge during the course of the grip, believing it due to small prostatic abscesses bursting into the urethra. These diathetic agencies are then surely concomitant factors, if not essential causes, of primary urethral inflammation, yet they are extremely rare.

Etiology of Simple Urethritis.—That the normal male urethra is immune to infection by any bacterium except the gonococcus is almost, but not quite, universally true. Most, if not all, cases of so-called simple or nongonorrheal urethritis occur in urethrae damaged by *gonorrhea* or by *sexual excesses*. Indeed, when the simple urethritis occurs in a canal that has not previously harbored the gonococcus, its origin will usually be found, not at the meatus, but in the prostate and seminal vesicles—evidence of its sexual cause.

The bacteria found in the normal urethra are those usually found in simple urethritis. But such important questions as "Is the bacterium an etiological factor?" and "Is simple urethritis transmissible?" have not been adequately answered. It seems probable that nongonorrheal urethritis is sometimes transmissible. I have obtained a streptococcus from the urethra of a man with simple urethritis similar to that obtained from a vulvar abscess in his wife. A few similar cases have been reported, but they are most exceptional.

In the opinion of the laity nonspecific urethritis may be acquired from a nongonorrheal woman at or near the period of menstruation. This opinion has as little foundation as that which attributes infectiousness to nongonococcic leukorrhea. The male who acquires urethritis from a menstruating or leukorrheic woman with whom he has previously cohabited with impunity acquires gonorrhea.

Pathology.—The lesion is a mild glandular catarrh. It may be most marked in the anterior urethra or in the prostate and vesicles.

Symptoms.—Simple urethritis is usually a very mild inflammation. There is little or no swelling of the meatus; the discharge is mild and often only mucopurulent; urination and erection are not painful. The incubation may be but a few hours or many days. The inflammation may last but a day or two or it may last many months.

These facts suggest that the condition of the patient's urethra and general health are of more importance than the bacteria.

The duration of the attack may be out of all proportion to its severity. I have known one to last several years.

Diagnosis.—Simple urethritis is distinguished from gonorrhea by

the absence of gonococci from the discharge. The mildness of the attack may be suggestive, but is not absolute proof.

The lesion does not require diagnosis until the first outbreak of discharge has been controlled by local treatment. But then a complete diagnosis should be made by rectal examination and urethroscopy.

Treatment.—At the outset the condition should be treated expectantly; i.e., by sandalwood oil, astringent injections and sexual hygiene.

Many cases are thus cured in a few days. But whether cured or not at the end of a week or so the urethra should be carefully explored by sound and urethroscope, the prostate and vesicles by massage, and treatment instituted as for the cure of chronic gonorrheal urethritis.

TRAUMATIC URETHRITIS

The causes are, *wounds of the urethra* by instruments, more especially crushing or bruising injuries. Bending the penis when erect, as in tempestuous and badly directed coitus, may be followed by mild urethritis (sometimes ushered in by hemorrhage and followed by traumatic stricture).

A foreign body in the urethra, such as retained stone, may give rise to a mild discharge.

Rough catheterism, a fortiori if the instrument be dirty, may produce urethritis, and the suppuration habitually attending instruments left indwelling in the urethra is too well known to require more than a statement of the fact.

Caustic injections of any kind may excite urethritis. Some urethras are very sensitive to the irritation of solutions of corrosive sublimate and carbolic acid, and much more so to the minutest dilutions of formalin, all of which substances, used as sterilizers of instruments, sometimes provoke the very mischief they would avoid.

NEOPLASTIC URETHRITIS

Papillomatous Urethritis.—The papillomata are exactly like subpreputial warts, varying greatly in size. Oberlaender[1] considers that papillomatous urethritis is only a more pronounced stage of the hypertrophic urethritis that sometimes follows gonorrhea. The diagnosis and treatment are urethroscopic (p. 203).

Other Neoplasms.—Other neoplasms of the urethra are less intimately connected with urethritis. They are described in Chapter LII.

[1] "Sajous's Annual," 1888, ii, 212.

SYPHILITIC URETHRITIS

Syphilitic chancre not infrequently involves one lip of the urinary meatus, more often perhaps the entire circumference, stiffening it, thickening the lips, and being more or less eroded and ulcerated down into the canal of the urethra. The discharge in these cases is very slight, but the sore lasts many weeks. Concomitant symptoms—inguinal adenopathy, spirochetes, etc.—clinch the diagnosis. The urethritis is only an epithenomenon.

But the chancre may be overlooked if it is situated at some distance within the urethra. The discharge is then slight, the incubation period long (unless, unhappily, there be double infection). There may be only the symptoms of stricture. But care will detect the enemy. A hard lump about the size of a pea, may usually be plainly felt from the outside, and the endoscope clears up the diagnosis by disclosing a gray or livid, bleeding ulcer.

I have also noted urethritis accompanying the development of a patch of tubercular syphilid upon the outside of the penis and disappearing under the use of mixed antisyphilitic medication by the mouth. Bassereau and Bumstead speak of a mucopurulent urethral flow coming on with the first appearance or with a relapse of secondary syphilitic eruptions, the cause of which was the development of syphilitic mucous patches upon the urethral mucous membrane. I have several times seen a patch of tubercular syphilid involve the urinary meatus and occasion a slight discharge. Gummatous ulceration of the balanitic urethra is not uncommon.

HERPETIC AND ECZEMATOUS URETHRITIS

That an attack of ordinary vesicular herpes may occur within the urethra is well known, although not common. I have seen a group or two of vesicles outside and a mild urethral discharge, with smarting on urination, coinciding with the attack and disappearing spontaneously with it. Alternating attacks, one outside, the next inside, have also been observed. Eczematous subjects sometimes suffer from a mild discharge coincident with a new outcrop of cutaneous eruption upon or near the genitals, or with the sudden disappearance of the outside eruption.

URETHRORRHEA

Urethrorrhea is a nonpurulent urethral discharge due to excessive secretion from the urethral glands. This discharge is mucilaginous

in consistence, bluish-white in color. It sticks the lips of the meatus together. When caught upon the finger it strings out in a gummy way.

When abundant it stiffens, but does not stain the linen. The microscope shows it to be composed of epithelial cells, leukocytes, films of striated mucus, granular *débris,* no pus threads (unless there be also chronic urethritis), no prostatic bodies, no spermatozoa, no lecithin bodies, no Boettcher's crystals.[1]

The causes of this affection are prolonged, ungratified sexual desire, constant impurity of thought, a sort of mental masturbation through the imagination, often indulged in by weak-minded youths, as well as by old men who are regretfully conscious that they are getting beyond the potential stage of sexuality. Another cause is delayed orgasm during intercourse or withdrawal before emission. Masturbation if excessive, or too much natural sexual exercise under the stimulus of mental provocation—all these and the like, being a violence to the various urethral mucous glands and to the circulation of the urethra by prolonged, sustained, excessive nervous tension, lead to passive congestion of the urethra and its glands and follicles, and thus occasion an excessive mucous secretion, together with more or less desquamation of pavement epithelium—and this is the whole malady.

The beading of the meatus during erection is physiological. It is equivalent to the watering of the mouth when one is hungry and smells appetizing food.

Treatment.—Urethrorrhea may sometimes be cured by local treatment, i.e., astringent injections, overdilatation or prostatic massage. But overzealous local treatment is calculated to irritate, and any injection may do as much harm as good, notably in those self-centered cases where morbid introspection is the salient feature of the malady. Here anything that keeps the patient's mind upon his genitals harms him, and any local treatment may be mischievous.

Indeed true urethrorrhea, be it due to whatever cause, gets slowly better with the elimination of that cause—be it lust, masturbation, excess, or what not—and by virtue of sexual and general hygiene.

PROSTATORRHEA AND SPERMATORRHEA

Prostatorrhea is the nonsexual discharge of prostatic fluid from the meatus. Spermatorrhea is the discharge of semen. The fluid is discharged by the act of the pelvic muscles, *usually during defecation,* rarely during urination. It is impossible to distinguish prostatorrhea

[1] The fluid must be examined in substance. It cannot be recovered by the pipette from urine since this dissolves it.

from spermatorrhea except by the aid of the microscope. The prostatic or seminal fluid discharged may be normal or purulent.

Etiology.—These conditions occur almost exclusively in young adults. They signify a relaxation of the prostatic or ejaculatory ducts due to sexual excesses or irregularities. They are not themselves inflammatory, though they may accompany inflammation.

Symptoms.—The sensible man pays no attention to these discharges; the neurotic attributes to them any symptoms of sexual debility from which he may suffer.

There is no such disease as spermatorrhea. The alleged malady is a fetich created by Lallemand; a fetich to which its morbid worshipers, young and old, bow down throughout the community morning, noon, and night, offering to it the incense of their distorted erotic fancies.

I have known men who had sexual intercourse nearly every night for years, who had no single symptom of any sexual malady, and surely, if an excessive expenditure of seminal fluid were in itself capable of producing symptoms, these individuals should have shown some of them.[1]

I have known every symptom attributed to spermatorrhea to occur in individuals who had no seminal loss whatsoever, voluntary or involuntary.

Finally, one often finds spermatozoa in the urine of vigorous men, ignorant of the fact, perfectly healthy in a sexual sense, and absolutely devoid of any of the alleged symptoms of the bugbear.

Therefore, spermatorrhea does not cause symptoms, does not interfere with bodily or sexual health, does not threaten life or entail any consequences, and it may be and should be wholly disregarded. The self-respecting urologist must give the lie to quackery and disabuse the public of false ideas on this subject.

That the prostate and vesicles may be kept empty by massage is, of course, true. But such treatment, by concentrating the patient's attention upon his genitals, is only calculated to bring him new misery when, with the cessation of massage, the discharge returns.

The only cure is common sense, the only relief matrimony.

[1] Let this not seem to imply approval of such gross abuse of the sexual function.

CHAPTER XX

DIAGNOSIS OF GONORRHEAL URETHRITIS

There are two essential features in the diagnosis of urethral gonorrhea. We must distinguish both the presence or absence of the gonococcus and the distribution of the urethral lesions.

Diagnosis of the gonococcus:

Differentiation between simple urethritis and gonorrhea.

Discovery of the gonococcus in chronic urethritis.

Diagnosis of the seat of the lesion:

In acute urethritis.

In chronic urethritis.

Urethroscopic diagnosis.

DIAGNOSIS OF THE GONOCOCCUS

Acute Simple Urethritis and Gonorrhea.—When a patient presents himself complaining of having contracted a gonorrhea, an inspection of his penis will often confirm or refute this opinion. If the lips of the meatus are red and swollen, exuding a creamy discharge, there can scarcely be a doubt of the specific nature of the infection. But *unless the urethral orifice is greatly swollen—unless there is ardor and chordee —an examination of the discharge is necessary to differentiate true gonorrhea from simple urethritis.* It may be that the gonorrheal inflammation is not yet well under way, or that there is chronic gonorrhea, of which this is an exacerbation, or, on the other hand, the whole matter may be a mere simple urethritis. In either case the discharge may be slight or profuse, watery or creamy. The microscope and "the Gram" are required for an immediate decision, to save the surgeon from the possibility of an erroneous diagnosis and to afford the patient the advantages of immediate local treatment.

I fear not everyone will accept the statement that nongonorrheal urethritis can simulate the true specific inflammation; but I have seen cases that went through a very fierce attack and proved exceptionally unmanageable; although the patients denied any sexual act for many weeks before the beginning of their attacks, while repeated microscopical examinations revealed no gonococcus in the discharge. In many other

cases the acuteness of the onset gave every promise of a true gonorrhea, but the negative microscopic evidence was confirmed by the rapid subsidence of the inflammation under a course of treatment that never could have conquered the gonococcus.

Discovery of the Gonococcus in Chronic Urethritis.—"May I get married?" The frequency with which the sufferer from gonorrhea presents himself with this question on his lips is a sad commentary upon the levity of youth. Yet it is a question which the practitioner is frequently—nay, commonly—called upon to answer. And upon the correctness of that answer the happiness of a household often depends. An error on the side of overcaution—forbidding a man to marry when he has a perfect right to do so—is only less heinous from the patient's point of view than the permission to marry before the danger of infection has passed. On the one hand there is the prospect of moral despair for both parties, on the other the certainty of infection of the innocent with all its train of physical woes and the possible discovery of the guilty partner, with results that need not be dwelt upon.

And unhappily the question is not an easy one to answer. So difficult is it, indeed, that scarcely any two authorities agree as to the criteria upon which the answer shall be based. Against the genial vagueness of the light-hearted practitioner, himself a *roué,* who proclaims that one is free from danger as soon as he is down to his customary morning drop, we may oppose the Spartan severity of those few authorities who assert that once a gonorrheic always a gonorrheic, once infected always infectious.

The broad-minded adviser will avoid either extreme. He knows full well that the majority of men who have had gonorrhea become and remain absolutely sound and clean. He recognizes also, that while most of those who exhibit the traditional morning drop are undoubtedly infectious, there remains an important minority even of these that cannot impart its disease, under whatever stress of sexual excitement. These are practical commonplace facts. We need not concern ourselves with those rare cases of alleged marital infection ten or twenty years after a cured gonorrhea. By their very nature such cases are open to a suspicion of that symptom common to all venereal disease, viz.: lying; and against them I can advance the experience of thirty-five years, during which countless patients have been advised to marry by my father and his associates with but a single error so far as I know. (And all will recognize the probability that such an error would rebound forcibly enough upon its perpetrator.) Such being the case, I am willing to assert the possibility of determining the presence of gonococci in any given urethra.[1]

[1] While the *diagnosis* may thus always be definite, the *prognosis* must remain indefinite. I can tell a man that he is or is not now infectious, but if he is now

When does the gonorrheic patient cease to be in danger of infecting the woman with whom he cohabits? Not until the gonococci have been entirely eliminated from him. The gonococcus is the sole infectious agent. If it is present, there is danger; if not, there is none. But to find the gonococcus is no easy matter. Its presence may be *suspected* on account of the symptoms the patient presents—and this clinical evidence was all we had to go by until within a few years—or it may be *proved* by the evidence which bacteriology has at last provided.

Clinical Evidence.—The clinical evidence of the presence or the absence of gonococci, which has been for so many centuries the physician's only criterion, is overshadowed nowadays by recent advances in bacteriology. Yet the bacteriologist is by no means infallible, and it is absolutely essential that the clinical evidence should accord before the laboratory is permitted to conclude that a patient is clean.

The notable clinical evidence of the presence of gonococci is pus, and in view of the prevalence of gonorrhea it is a general rule that *whenever there is pus anywhere in the genital or the urinary tract the presence of gonococci may be suspected, and conversely when the whole tract is proved free from pus the presence of gonococci may be denied.*[1]

Clinically speaking, a great many classes of cases may be ruled out at once. Thus, gonorrhea of the kidney is very rare and never occurs except in conjunction with gonorrhea of the lower urinary passages. Similarly the history of suppuration due to prostatism, stone, tubercle, or tumor is usually such as to rule out gonorrhea. The cases that come for diagnosis may be divided into three classes:

First, those who, having had gonorrhea, continue to have pus in the urine or are subject to relapses of pyuria or urethral discharge.

Second, those who, having had gonorrhea, whether they allege a continuance of the discharge or not, are not subject to acute relapses, no matter how much sexual and alcoholic dissipation they indulge in.

Third, those who, after a gonorrhea, have no longer a discharge or any other symptom, show perfectly sparkling urine and from whose prostates and vesicles no pus can be expressed.

Of the first class the majority are still infectious; of the second class the majority are no longer infectious, while all who continue in the third class for a month are certainly free from gonococci and from all danger. For these last, then, the clinical diagnosis suffices; for the others there is only a probability from which the experienced physician may often

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infectious I cannot tell, with any certainty, when he will become clean. That is a matter of relative immunity, severity of lesion, faithfulness to treatment,—details differing for every case.

[1] With the single exception that the patient may have just been infected and may still be in the incubation period.

reach an assured conclusion one way or another, but a probability which always deserves to be confirmed by scientific tests.

The following points are also of assistance in the clinical diagnosis:

The presence of shreds in the urine, even when those shreds contain pus cells, is not probable evidence of the presence of gonococci unless free pus appears in the urine from time to time. Indeed pus shreds appear constantly in the urine of many men who never had gonorrhea.

When the discharge and the centrifuged urinary sediment show a preponderance of epithelial over pus cells gonococci are very probably absent.

When the gonorrhea has lasted three years without reinfection gonococci have doubtless disappeared.

Finally, the clinical evidence is much fortified by excitation of the urethra. To this end the patient may be put through the following three tests at intervals of forty-eight hours: vigorous prostatic and vesicular massage, three glasses of beer, dilatation with a Kollman dilator. If these three tests fail to excite a discharge from which gonococci may be cultivated, the gonococci have almost certainly disappeared, even if the urine or expressed prostatic secretion continues to show pus.[1]

Laboratory Evidence.—The consulting urologist is besieged by patients who, at the close of a gonorrhea (with urethrae more or less completely healed), are gonococcus-free as far as the complement deviation test, culture, and clinical signs can prove, and who yet are driven to an agony of doubt because they continue to show a few intracellular, Gram-negative cocci (degeneration forms of staphylococci) and pus cells.

The mere presence of Gram-negative intracellular diplococci in a chronic urethritis does not warrant the diagnosis of gonorrhea, unless these are numerous and typical (p. 111).

Therefore the examination of smears decolorized by the Gram method is a peculiarly misleading test of the cure of gonorrhea, unless the examination is made by a peculiarly expert bacteriologist.

The only laboratory tests worthy of credence are the complement deviation test and culture. The practitioner who cannot command one or both of these must perfect himself in the clinical diagnosis and rely upon this.

The complement deviation test is not reliable until the patient has had posterior urethritis at least two weeks. But the more chronic and the milder the urethritis the more reliable is this test in comparison to culture, which is most accurate in active, recent cases.

Practical Method.—When the gonococci seem clinically to have disappeared, when the application of the beer, massage and dilatation

[1] Injection of gonococcus vaccine may excite hidden gonococci; but this test is not infallible.

test no longer excites a discharge loaded with Gram-negative intracellular diplococci, we apply the following test:

1. Wait two weeks.
2. Then apply the complement deviation test, and
3. Examine by smear and culture—
   (a) The urethral discharge.
   (b) The first urine passed (centrifuged).
   (c) The urine passed after massage of the prostate and vesicles (centrifuged) or the expressed secretion from these glands.

The specimens must be taken directly from the patient at the laboratory and examined before they grow cold.

DIAGNOSIS OF THE SEAT OF THE LESION

DIAGNOSIS OF THE DISTRIBUTION OF ACUTE URETHRITIS

Acute nongonorrheal urethritis may originate either in the anterior or the posterior urethra. The diagnosis of its origin and extent is conducted precisely as is that of chronic urethritis.

Acute gonorrheal urethritis always begins in the anterior urethra. The pouting meatus and creamy discharge amply attest the presence of anterior urethritis. But to diagnose the presence of posterior urethritis is not always possible.

If both the first and second flows of urine are cloudy there is posterior urethritis.

If only the first flow is cloudy, there may be posterior urethritis. This is negligible for the time, but may cause trouble later by delaying the cure. In other words, the mere fact that throughout a carefully observed gonorrhea the second urine has always been clear by no means eliminates posterior urethritis, and in the event of such a urethritis becoming chronic the posterior urethra must not be neglected.

Examination and massage of the prostate reveal lesions in that organ as in chronic urethritis; but in view of the freshness of the infection this examination should be conducted with the utmost gentleness.

DIAGNOSIS OF THE DISTRIBUTION OF CHRONIC URETHRITIS

Since it is not my custom to use the urethroscope in the diagnosis of gonorrhea except in rebellious and protracted cases, I prefer to describe the routine method of examination followed at the patient's first visit, leaving the matter of urethroscopic diagnosis for subsequent discussion.

Upon accurate diagnosis depends the patient's prospect of cure, and

such diagnosis, even without urethroscopy, may require several examinations.

The patient presents himself with a history of chronic or relapsing urethral discharge, with shreds or pus in the urine, or with various sexual or painful symptoms.

The First Examination.—The examination for gonococci already described takes first place. The routine examination of the lesion is as follows:

1. The meatus is examined for discharge (and a smear taken for microscopic examination) and inflammation, the urethra for nodules of periurethral infiltration, the testicles for evidence of epididymitis.

2. The patient then urinates in two glasses, as described in Chapter II.

3. A 16 F. catheter is introduced, the site of pain, bleeding or obstruction noted, residual urine estimated (to be confirmed by subsequent examination), and about 100 c.c. of saturated boracic acid solution injected into the bladder.

4. Prostate and vesicles are then massaged; any expressed secretion is caught upon a slide for examination.

5. The patient then empties the bladder into two glasses, if no secretion has been expressed by massage; otherwise into one. If residual urine is suspected, this is verified by measuring the amount passed.

From this examination we glean the following diagnostic points:

Anterior Urethritis.—Usually pus at meatus. Second flow of urine clear. No abnormality felt in prostate or vesicles. No pus in the secretion expressed from these organs or in boracic acid solution.

Posterior Urethritis.—No pus at meatus, unless there is anterior urethritis as well. (Clinically there is almost always enough anterior urethritis to produce a morning drop.) Second flow of urine may be clear or cloudy. Prostate and vesicles feel normal, but in the secretion, expressed or centrifuged from silver solution, there are a few pus cells.

Prostatitis.—Same as posterior urethritis except that indurations or abnormalities of contour are usually discerned in the prostate, and the expressed secretion is frankly purulent. There may be residual urine.

Vesiculitis.—Same as prostatitis, except that vesicles are distended or indurated. Just as there is always prostatitis with vesiculitis, so there is often impalpable vesiculitis with prostatitis. The attempt to distinguish the expressed secretion of the two is likely to prove misleading, for though a large part of the vesicular secretion floats in urine, pus from the vesicle, like pus from the prostate, sinks.

Stricture.—Marked stricture obstructs or prevents the passage of the catheter. Slight stricture is not diagnosed until a subsequent exam-

ination. Cicatricial or prostatic obstruction at the neck of the bladder gives residual urine.

Cystitis.—It is probable that some inflammation of the bladder, or at least of the trigone, exists whenever the second flow of urine is purulent. But this cystitis is a negligible quantity that disappears long before the posterior urethritis is cured. Retention cystitis is, of course, important.

Pyelonephritis.—The diagnosis of gonorrheal pyelonephritis offers no peculiar difficulties excepting in so far as urethritis prohibits cystoscopy. The renal colic due to vesiculitis and the lumbar pain due to epididymitis are distinguished by physical examination.

Object of This Method of Examination.—The object of this examination is to obtain the maximum of information about the patient while doing him the least possible harm. By it the precise lesion in the anterior urethra is not as accurately determined as though the urethroscope were used. But the risk of stirring up a urethra whose temper is not known warrants deferring this more precise examination to a subsequent date (the following day, if the patient cannot be kept under observation), but preferably after a few days of treatment, unless the case is very chronic and the temper of the urethra has already been well tested by others.

Secondary Examination.—In order to obtain precise information as to the condition of the anterior urethra one must use an exploring instrument. I usually employ a 26 F. sound. (The meatus may have to be cut.) If this is grasped there is stricture. If it is not grasped but brings blood (not from the meatus) there is anterior urethritis. The precise surface conditions of both anterior and posterior urethra are determined by—

Urethroscopy.—See Chapter XXI.

The Bulbous Bougie.[1]—The largest bougie that will pass the meatus is lubricated and passed gently into the anterior urethra. As it advances the physician notes the position of every obstruction and even of every sensitive spot encountered. When it is just entering the bulbous portion of the canal it is withdrawn and the obstructions encountered verified as the instrument passes over them again on its way out. The bulb is then carefully examined and wiped off to discover traces of blood or pus upon it. It is then reintroduced rapidly to the bulbous urethra and, aided by firm counter-pressure on the perineum, insinuated into the membranous urethra.

By this examination we distinguish any stricture or erosion in the anterior urethra and locate it with considerable accuracy.

For an efficient examination the bulb must be 26 F. in size. Any meatus too small to admit this must be cut (p. 767).

[1] This is an instrument I do not employ.

A 26 F. bulb detects infiltrations that do not perceptibly encroach upon the caliber of the urethra. If the bulb detects nothing and anterior urethritis is nevertheless suspected, its presence is shown by urethroscopy.

Contra-indications to the Method.—Acute relapses or complications (e. g., in prostate or testis) prohibit instrumental examination until they shall have passed.

Inferences Drawn.—The diagnostic horizon is not limited by physical signs. We find by our examination that the patient has this, that, or the other lesion; indeed, we usually find that he has several lesions. But before the diagnosis is really complete we must know which is the predominant lesion and what part the patient's general condition plays.

Our examination reveals, let us say, prostatitis, anterior and posterior urethritis. Under these conditions we may feel confident that one of these lesions is more important than the others; is indeed the underlying lesion that keeps the others going. It may be that prostatic massage alone will cure the case promptly and permanently. Or maybe posterior irrigation is required. Or perhaps any attack of the posterior urethra does harm and the patient will recover on an interior injection. Or dilatation may help. Or any local treatment may irritate.

These are not theoretic possibilities but practical facts. Diagnosis of the lesion is necessary, but an absolute therapeutic conclusion can rarely be drawn from that diagnosis. We must feel our way and try first one treatment and then another.

Concerning Shreds.—The purulent urine of acute urethritis does not contain shreds, but as the inflammation subsides and tends to become localized little scabs form upon the more inflamed areas and are washed away in the urine. These are called shreds (Tripperfaeden). They consist of a mass of mucous or fibrous matter entangling pus and epithelial cells. To the general practitioner shreds simply mean that the general inflammation is subsiding or has subsided. When, day by day, the urine shows less pus and more shreds, conditions are improving. The following general observations concerning shreds seem warranted:

1. Shreds are no index of gonorrhea. They are currently found in the urine passed by men who have never had gonorrhea.

2. The shape and size of shreds do not indicate what part of the urethra they come from.

3. Shreds mean chronic localized inflammation of the urethra.

4. Shreds heavy with pus sink rapidly in the urine. They indicate relatively active inflammation or ulcer or stricture.

5. Lighter shreds often testify to an inflammation so mild that it presents no dangers and is entirely uninfluenced by treatment.

6. Shreds call for treatment by dilatation or urethroscope (unless this irritates).

CHAPTER XXI

URETHROSCOPY

URETHROSCOPES

The urethroscope has not been as fully perfected as the cystoscope. The models of the latter in use today are practically standardized; but the former will doubtless undergo many changes for the better in the course of the next decade. We may describe four types of urethroscope. Each of them may be employed to examine the whole of the urethra, but we restrict our description as though the instrument were employed only upon that portion of the urethra to which it is best suited:

1. The straight tube with air distention (for examination and treatment of the anterior urethra).
2. The straight tube with water distention (for examination and treatment of the posterior urethra).
3. The Goldschmidt or Buerger type (for examination of the posterior urethra and treatment of the anterior or posterior urethra).
4. The Swinburne type (for treatment of the verumontanum).

THE STRAIGHT TUBE

This is practically the same instrument as was used by Desormaux. The familiar model consists of a nickeled tube 12 cm. long, at the outer end of which is attached a collar whereby it is manipulated, and to which is attached the source of light; a straight obturator fits into the instrument.

Source of Light.—The light may be reflected from a head mirror; or may be reflected or thrown directly into the tube from an attachment at its outer extremity. This has the advantage of leaving the caliber of the tube free for manipulations and minimizing the danger of infection. It has the disadvantage, however, of throwing a light that is relatively dim. Instruments of this type are sold in this country under the names of Otis and Young. Internal illumination, as it is called, is derived from a small cold Koch lamp which is inserted into the instrument up to its internal extremity; such are the instruments of Chetwood, Valentine, etc. We prefer internal illumination,

whose brilliancy more than makes amends for the room which it occupies.

Uses.—This simple open tube affords the best means of examining and treating the anterior urethra. It may also be employed in the posterior urethra, but is relatively difficult to introduce, and inefficient as compared with the instrument next described.

The Straight Tube with Water Distention

Ever since the invention of the urethroscope, attempts have been made to use it in the posterior urethra. But if used without any distention the edge of the tube is likely to excite bleeding that obscures the field of vision more rapidly than it can be wiped off. Hurry Fenwick, Mark, and others have endeavored to overcome this difficulty by employing air distention. The objection to this is its danger. Dr. Mark has reported a collapse due to air embolism; and I know of one death (unreported).

Water distention is ideal. It washes away the blood and distends the posterior urethra. One may employ a wall tank, elevated at least three feet above the patient, or a piston syringe. The elbow obturator devised by Luys facilitates the introduction of the tube. By using various degrees of distention as one withdraws the instrument, the posterior urethra may be fully examined. For the anterior urethra this instrument is not quite as satisfactory as the simple open tube.

The instrument I employ bears the name of Gehringer. It is supplied with internal illumination, irrigating stop-cocks and a tube for the admission of electric wires.

THE FENESTRATED URETHROSCOPE

Goldschmidt's urethroscope was the first to provide a practical means of examining the whole posterior urethra. His instrument was soon improved upon by Buerger, who, by means of a prismatic mirror, made his urethroscope an instrument of great value for the treatment of urethral lesions. Although Goldschmidt's instrument includes a large armamentarium of implements for the inspection or cauterization of cysts, papilloma, inflammation of the glands, and even prostatic bars, the instrument has been but little used in this country.

With *Buerger's cysto-urethroscope* (as it is called) one may make applications with great precision to lesions anywhere in the urethra. But for diagnosis the straight instrument is superior inasmuch as it throws the lesions, especially the papillary ones, into relief; whereas with the Buerger instrument, whose line of vision is at right angles to the shaft, one may overlook such lesions.

The MacCarthy urethroscope is an improvement of Buerger's instrument.

The Swinburne urethroscope is a straight open tube, cut obliquely at its internal end, and with a solid curved beak to facilitate its introduction into the posterior urethra.

This is the ideal instrument for making applications to the verumontanum.

TECHNIC OF URETHROSCOPY FOR DIAGNOSIS

Anterior Urethra.—The patient may lie on his back, though it is usually wiser to precede or follow the examination of the anterior urethra by that of the posterior; and, for this, it is more convenient to have the patient in the usual cystoscopy position. No anesthesia is required. The tube is lubricated, the glans penis cleaned, the tube introduced, directed downward until it will go no further, then it is gradually inclined to an angle of 60° or more. The operator then steadies the tube with his left hand; the forearm steadying itself against the patient's body. The obturator is then removed with a gentle rotary movement to disturb the tube as little as possible. The source of illumination is then affixed and one looks for the orifice of the membranous urethra. Usually the tube has not been bent over far enough; one sees only the floor of the bulb. By rotating the tube still further downward the puckered lumen comes into view; then the tube is slowly withdrawn, at such an angle as to keep the lumen of the canal in the center of the field of vision.

The tube is slowly withdrawn, all parts of the canal being inspected as they pass under the eye; blood, pus or lubricant is mopped away with a cotton swab on a wooden applicator.

Normal Anterior Urethra.—The walls of the urethra fall together over the end of the tube to make a hollow cone. The mucous membrane varies in color from pale to salmon pink. The absence of inflammation is evinced by the suppleness of the walls of the canal which fall together in longitudinal folds from four to twelve in number, radiating from the center to the circumference of the field; between these folds the pink mucosa is lined by longitudinal deep red striae. Upon the roof of the urethra (and less frequently upon its floor) the crypts of the Morgagni appear as deep red indentations (the normal ducts of Littré's glands are invisible).

In the bulb the lumen of the urethra forms a lateral slit; openings of Cowper's ducts upon the floor of the bulb are usually concealed by a fold of mucous membrane.

The navicular urethra is pale and rigid; the lumen is a vertical slit;

there are no folds or striae; the opening of the lacuna magna is seen upon the roof.

The Inflamed Anterior Urethra.—When subacutely inflamed[1] the surface is red and velvety. The gloss and the brilliant red striae are lost. The swelling of the mucous membrane reduces the number of longitudinal folds. Patulous crypt orifices are seen exuding pus.

Mild chronic anterior urethritis (soft infiltration) shows much the same picture. The redness is not so marked, the luster of the surface may be increased, but the striae are lost, the folds reduced, the crypts red, patulous, purulent, or cystic.

Severe chronic anterior urethritis (hard infiltration) in which the inflammatory exudate has been largely converted into scar tissue shows a gray, eroded, lusterless surface with no striae, few or no folds. The ducts of Littré's glands may project as minute vivid red points in the midst of a mass of congestion (glandular type) or these red spots may be absent (dry type). Sclerotic white patches or stellate white scars may appear here and there.

Posterior Urethra.—The cystoscopic position is the most convenient. Local anesthesia is quite as necessary as for cystoscopy, and is obtained by the same methods (page 51). The urethroscope is introduced like a cystoscope until its orifice is in the bladder. The obturator is then withdrawn, the bladder emptied, the attachments for illumination and irrigation connected, and the irrigation conducted so that a gentle stream of water is constantly flowing into the instrument. This is withdrawn in the long axis of the patient's body until the bladder neck comes into view.

The Normal Posterior Urethra.—The normal bladder neck appears as an irregularly rounded orifice, the edges of which consist of a series of folds over which course a number of irregular blood vessels. As the tube is gradually withdrawn the walls of the posterior urethra appear in the field of vision, but do not close the canal or hide the opening of the bladder neck, until the tube has been withdrawn almost to the verumontanum. Looking close one may see the ducts of the prostatic glands upon the floor of the urethra on each side of the median line. As the tube is withdrawn a little further the verumontanum comes into view, an irregularly shaped, rather edematous rounded body, arising from the floor of the urethra, and filling the field.

When the verumontanum has been brought fully into view a little variation in the force of the water stream will wash it clear of the bleeding which is likely to result from the pressure of the tube, and will make the verumontanum bob up and down, bringing into view the opening of the sinus pocularis. If the ejaculatory ducts open at or near the edges of the sinus these are visible as depressions, somewhat

[1] Acute urethritis absolutely contra-indicates urethroscopy.

larger than those of the prostatic ducts. Immediately in front of the verumontanum the membranous urethra comes into view as a more rigid, very red mucous membrane; as the tube is withdrawn into the bulbous urethra it is released from the grip of the sphincter with a sudden jump.

The Inflamed Posterior Urethra.—Inflammation in the posterior urethra may exhibit simply an excessive tenderness and redness of the mucous membrane, with obliteration of the blood vessels. The orifices of the ducts may be unnaturally prominent, and a purulent exudate may perhaps be expressed from them. Chronic inflammation commonly results in the production of little granulomata which look like warts, and are sometimes spoken of as polyps. The straight tube almost always reveals one or more of these. Bright pearly cysts are occasionally seen.

The Inflamed Verumontanum.—So various are the shapes and sizes of the verumontanum that it is difficult to describe the normal. Changes in the verumontanum are doubtless always associated with inflammation of the sinus pocularis (Geraghty and Rytina). Apart from the presence of little granulomata, inflammation is likely to cause an enlargement of the verumontanum, irregular in outline. But so great are the normal variations in size and shape of the verumontanum that no diagnosis of inflammation can safely be made from the appearance of the verumontanum alone, except by an expert urethroscopist.

Prostatism.—Urethroscopic examination of the enlarged prostate reveals the lobes projecting into the urethra just as cystoscopy reveals them projecting into the bladder. The lumen of the urethra is markedly enlarged so that the end of the tube must be moved up and down in order to see the whole cavity; the mucous membrane is usually inflamed.

Carcinoma of the Prostate.—Inasmuch as carcinoma often does not invade the mucosa, there may be no change in the urethroscopic picture. But when the carcinoma has so compressed the urethra as to cause retention, the mucosa at the bladder neck usually appears dark red, and the orifice is likely to be somewhat irregular in outline; while less often ulcerated and fungated areas of inflammation may be seen projecting into the bladder neck, or into the bladder itself.

URETHROSCOPIC TREATMENT

Anterior Urethra.—Urethroscopic treatment of the anterior urethra is calculated to benefit only those cases that show distinctly localized granulomata or suppuration. The unskilled urethroscopist always sees a few reddened or infiltrated spots along the urethra; wastes his time in cauterizing or incising these and accomplishes nothing, for in most

cases the underlying lesion is a widespread sclerosis, to be influenced only by general dilatation. Yet there are exceptional cases: ulcers and granulomata to be cured by cauterization with 20 per cent silver nitrate solution, or by the high frequency current; single suppurating glands to be drained by incision and healed by applications of silver nitrate solution once a week or so; long para-urethral ducts exudating pus and requiring that they be slit to the bottom and then cauterized. Yet the neophyte will not profit by attempting this form of local treatment.

Treatment of the Posterior Urethra.—The inflamed posterior urethra usually requires no local treatment beyond the familiar irrigation, instillation, massage and dilatation. Granulomata may sometimes be cauterized with advantage. The high frequency spark must be employed for this purpose. Cysts may be punctured by the spark or by the knife (but these treatments often do the patient no good).

Treatment of the inflamed verumontanum, interest in which was revived by Swinburne a decade ago, must be conducted with intelligence and caution. Geraghty has cured intractable cases by irrigation of the sinus pocularis through a small catheter with one per cent silver nitrate solution. Rytina hopes to improve drainage by guillotining the verumontanum with a special instrument. Swinburne has had great success in control of pain, and the cure of such sexual irregularities as premature ejaculation and nocturnal emissions, by the application to the verumontanum of 20 per cent silver nitrate solution through his posterior urethroscope. None of these methods of treatment should be employed upon cases that can be cured by milder means (notably by instillations). None of them should be persisted in if they prove outrageously painful. Cauterization should not be repeated oftener than once in two weeks. Swinburne applies the silver nitrate solution rather lavishly upon a swab, and then neutralizes it with salt solution. I prefer to use a swab only slightly moistened with the silver nitrate solution, or to use the solid stick. I also employ very sparingly liquor hydrargyri nitratis pure or in 50 per cent solution. Irrigation of the sinus pocularis is most likely to be beneficial in cases characterized by painful emissions. But the whole subject is as yet obscure. Cases that one would expect to help often resist treatment; while unpromising ones sometimes improve rapidly.

CHAPTER XXII

METHODS AND DRUGS EMPLOYED FOR THE LOCAL TREATMENT OF URETHRITIS

Local treatment of the urethra is administered in the following ways:

Injection with small piston syringe.
Forced irrigation with piston syringe.
Forced irrigation with wall tank.
Catheter irrigation.
Instillation of fluids.
Instillation of ointments.
Urethroscopic applications.
Rectal massage.
Rectal irrigation.

METHODS EMPLOYED

Preliminary.—The patient should empty his bladder, if he can, immediately before any treatment is applied to the urethra.

INJECTION

The instrument employed is a two dram glass or hard rubber syringe. The tip may be of soft rubber and should be blunt, so as not to injure the urethral mucous membrane.

The syringe is filled and its nozzle applied *within* the lips of the meatus. To accomplish this these lips must be gently drawn apart, the nozzle inserted snugly between them, and the lips then carefully pressed against the syringe, while the injection is made by *slowly* depressing the piston.

The pressure upon the meatus should be lateral, not from above downward. If the fluid is to be retained more than a moment the syringe is withdrawn while the lateral pressure is continued.

Excepting in the prophylaxis of gonorrhea, there is never any reason to prevent the solution from entering the bulbous urethra; no pressure should therefore be put upon the urethra at the penoscrotal angle. If

gently and intelligently performed, the injection will never irritate the posterior urethra or the epididymis.

In the first days of a gonorrhea injections may be repeated as often as every three hours, thereafter not oftener than three or four times a day, and in chronic gonorrhea not oftener than once or twice a day.

Some patients can voluntarily relax the external sphincter and permit the injection to flow into the posterior urethra. This may be encouraged by massaging the urethra with one hand while holding the meatus with the other. But this practice is not without danger and should be employed only in chronic cases.

FORCED IRRIGATION

The motive force is obtained either from a large (150 c.c.) piston syringe or from a wall tank so arranged that it can be lowered or raised at will. The nozzle I employ on the syringe is a soft rubber tip removed from a glass urethral syringe. For the wall tank, the nozzle usually employed is some modification of the Janet's nozzle, shield, and cut-off. One may use the Chetwood scissors and two-way glass nozzle for irrigating the anterior urethra, the Swinburne cut-off and shield and the Janet (the so-called Valentine) nozzle for the irrigation of the posterior urethra.

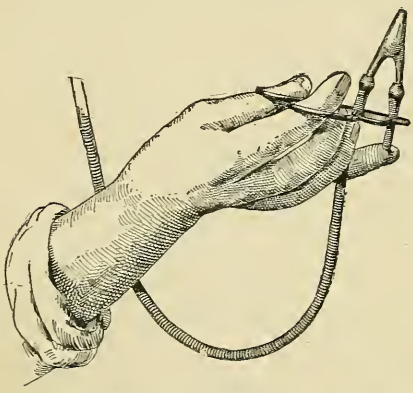


Fig. 40.—Chetwood Irrigation. Filling the nozzle.

The tank is more convenient than the syringe for anterior irrigation. The level of the fluid in the tank should stand one to two feet above the urethra. For posterior irrigation either tank or syringe may be employed. In order to force the sphincter the tank must be raised three to five feet above the urethra. The sphincter may be forced more gently with the hand syringe [1] than with the tank. With it one appreciates and yields to the varying pressure of the sphincter, forcing the fluid vigorously only when this resistance is overcome.

To irrigate the anterior urethra 1,000 c.c. is generally used. This is run in and out of the urethra by alternately approaching the nozzle and opening the Swinburne cut-off and removing the nozzle while closing the cut-off. The force of the inflow is gauged by the patient's sensations, which should not be painful, and the sense of urethral dis-

[1] The Janet, Janet-Frank, and Janet-Hayden are the best.

tention imparted to the fingers holding the meatus. The shield catches the splashing outflow.

Instead of this slopping way of irrigation I prefer to employ the Chetwood scissors shut-off and two-way nozzle.

The nozzle and scissors are attached and the instrument filled in the manner shown in Fig. 40. The nozzle is then applied to the meatus (Fig. 41) and the scissors alternately opened and shut, permitting intermittent irrigation of the canal.

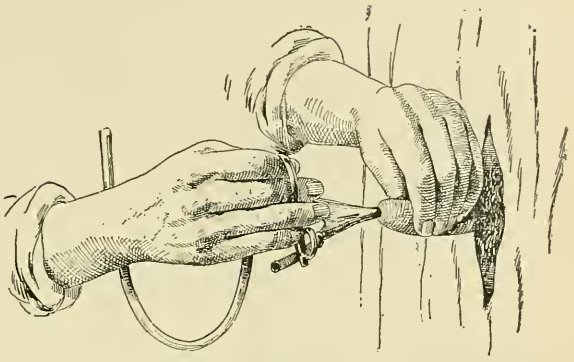


FIG. 41.—CHETWOOD IRRIGATION. Inserting the nozzle.

CATHETER IRRIGATION

The catheter is introduced as described in Chapter IV. If the anterior urethra is to be irrigated the catheter should be not larger than 15 F. and should be introduced (about 12 cm.) into the bulbous urethra.

If the posterior urethra is to be irrigated the catheter (16 to 18 F.) should be introduced until its eye enters the bladder and a few drops of water flow away. As soon as the bladder has thus been drained the catheter is withdrawn 1 to 2 cm. into the posterior urethra. The fluid is then introduced by tank or syringe. If the patient can empty his bladder the catheter is then withdrawn and the fluid urinated out. If there is retention the fluid must be withdrawn by pushing the catheter back into the bladder. If the retention is slight either method may be followed.

INSTILLATION

The Keyes or the Guyon instillator may be employed for fluids; only the former can be used with ointments. The object of instillation is to place upon a given portion of the urethra a few drops of a solution so concentrated that it could not be used over an extended area or in large quantity.

The instillator is introduced like a sound or a woven catheter. Inasmuch as the instillation is usually intended for the prostatic or the membranous urethra, one should have a clear idea of the precise position of the instrument as its tip enters the posterior urethra. The

Fig. 42.—Tip of Instillator in Bulbous Urethra.

Fig. 43.—Tip of Instillator in Posterior Urethra.

jump as it passes the external sphincter is often quite palpable; but in case of doubt one may always feel confident that when the instrument has reached a point in the urethra where its shaft rests without pressure at any angle between the perpendicular and the patient's feet, its point is in the membranous urethra (Figs. 42, 43). Beyond this the instrument should not be introduced. The fluid injected will bathe the whole deep urethra.

In order to instill an ointment I employ a screw-piston syringe screwed to the Keyes instillator. The syringe must be taken apart for filling. I see no peculiar virtue in any of the numerous ointment applicators that are devised from time to time.

URETHROSCOPIC APPLICATIONS

For urethroscopic applications see p. 203.

RECTAL MEDICATION

On account of its proximity to the posterior urethra, the rectum has always been a favored receptacle for drugs intended to benefit the urinary canal, especially when that channel was too acutely inflamed to permit local applications directly to it.

Opium and antipyrin to relieve pain, and ichthyol and iodoform to reduce inflammation, are the drugs in vogue. I have had no luck with any of them. Opium is more efficient when given by mouth or by hypodermic, and rectal irrigations of hot and cold water have proven much more efficacious than any chemical medication by this route, while massage, if permissible, is more efficacious still.

Massage.—The way to examine the prostate and seminal vesicles by rectal touch has been described in Chapter I. Massage of these organs, to be intelligent, requires familiarity with their normal contour. The technic of massage is described on p. 242.

Antisepsis.—Inasmuch as the prostate and vesicles may contain gonococci, the extension of which into the urethra is quite likely to set up acute urethritis, or other bacteria that may cause a milder infection, as a general rule the urethra should be flushed with some antiseptic after massage. The easiest way to accomplish this is by filling the bladder with potassium permanganate (1 : 3,000) or silver nitrate (1 : 5,000) before the massage, and instructing the patient to emit this afterwards. Instillation of silver salts may also be employed.

If the temper of the urethra is well known the antisepsis may be omitted in certain cases. It is then better to have the patient retain some urine with which to flush the canal after massage.

Irrigation.—Rectal irrigation may be given either by a closed tube,

the psychrophore, through which the water flows in and out, or by a double-current tube. The former is a much neater instrument to use, but it does not impart so much heat (or cold) to the patient as does the double-current tube.

If no double-current tube is to be had, Tuttle's apparatus may be employed. It consists of two large soft-rubber catheters, bound or sewed together, side by side. The water flows in through one, out through the other. When the outlet is plugged with feces, the current is reversed.

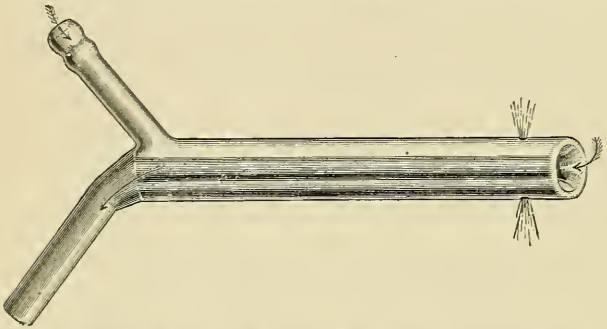


Fig. 44.—Chetwood's Tube for Rectal Irrigation.

Of the special tubes, I find Chetwood's model (Fig. 44) more convenient than those of Kemp or Tuttle.

The patient fills a two-quart douche bag, attaches it to the tube, hangs the bag so that its elevation above the outflow shall be about two feet, and greases the tube with vaselin. He then seats himself toward the back of a privy seat, leans back against the wall, opens the cut-off of the douche bag until the water flows warm through the tube, and then inserts the tube into the rectum for about half its length. He then turns the water on, and it flows into the rectum. If it does not return through the outflow, he stops the inflow as soon as the rectum feels full, pokes about with the tube until a gush of water announces that it is in the right position, then turns the water on again. It often takes from four to eight attempts before the patient learns to do the trick neatly.

The douche is usually employed once a day. The fluid is water at a temperature of 120°-130° F. (as hot as the finger can bear). Exceptionally, cold water (50° F.) works better than hot.

SOLUTIONS EMPLOYED

All solutions to be employed in the urethra or bladder should be made freshly with boiled water in the manner described in Chapter III.

The following list represents the solutions usually employed, the form in which they are most conveniently kept, and the strength in which they are usually dissolved. The list might be doubled or trebled without being exhaustive. The remedies are classified in a purely

arbitrary way. Manufacturers' claims as to silver content of the organic compounds are disregarded as being of no clinical importance.

Name.	Form.	Injection.	Irrigation.	Instillation
Argyrol	Crystals	5–20% [1]	3 –10%	10–50%
Protargol	0.5 gm. powders	0.25–1% [1]	0.1–0.5%	1–5%
Albargin	0.2 gm. tablets	0.1–1% [1]	0.05–0.2%	1–5%
Potass. permang	1 gr. tablets	.....	0.01–0.05%	.....
Silver nitrate	10% sol	.....	0.01–0.02%	0.1–10%
Silver permang	*see* text	.....	.....	.....
Hg. oxycyanid	0.25 gm. powders	.....	0.01–0.05%	.....
Zinc sulphate	1% sol	.....	0.1–0.5%	.....
Zinc acetat	*see* text	0.2–0.5%	.....	.....
Zinc permang	1% sol	.....	0.05–0.2%	.....
Copper sulphate	10% sol	.....	0.5–4%	0.5–5%
Vegetable astringents	*see* text	.....	.....	.....
Ointments and bougies	*see* text	.....	.....	.....

[1] Must be retained three to ten minutes in the urethra.

First and foremost, let us condemn the use of any local anesthetic as a preliminary to urethral injection in acute gonorrhea. This masking of the natural irritative reaction is an unwarranted and dangerous procedure.

THE ORGANIC SILVER SALTS

War still rages as to the relative value of the organic salts of silver. Thus Marshall and Neave,[1] experimenting upon the staphylococcus pyogenes aureus, showed that whereas the majority of silver salts experimented with were powerfully bactericidal, argyrol showed no such effect. Cragin, comparing the effects of silver nitrate, protargol, and argyrol on streptococcus, staphylococcus pyogenes aureus, and gonococcus, showed both the latter to be markedly inefficient except against the gonococcus, which was killed in thirty seconds by 5 per cent protargol and 20 per cent argyrol, in three minutes by 2 per cent, and in twelve minutes by 1 per cent protargol, in twenty minutes by 10 per cent argyrol. Burnett,[2] experimenting on dogs, found that neither argyrol nor silver nitrate showed any power to penetrate the urethral mucous membrane. The report of Puckner[3] and its discussion exemplifies the impracticability of classifying these salts by any laboratory standard.

The only standard is that of the clinic. The clinic decides that the organic silver salts are, by virtue of their power to destroy gonococci and

[1] *Brit. Med. Jour.*, August 1, 1906.

[2] *Am. Assoc. of G.-U. Surgeons*, 1903.

[3] *Jour. Amer. Med. Assn.*, October 20, 1906.

their relative lack of irritation to the urethral mucous membrane, the best remedies against acute gonorrhea, and useful in chronic gonorrhea in proportion as the urethra is hypersensitive and irritable to other remedies. But in nongonorrheal or postgonorrheal urethritis, acute or chronic, the organic silver salts are all but useless.

Argyrol.—Argyrol is the least irritating of these remedies, and is accordingly the most useful in acute gonorrhea. Yet even argyrol may irritate. I have seen three patients who could not employ it, and two others with prostatic abscess due to its intemperate use. Yet argyrol is so filthy that one gladly employs one of the other salts in its stead as soon as the urethra will permit. The stains of argyrol may be removed by immediate washing or by prolonged soaking in 1:500 corrosive sublimate solution.

Protargol.—This is fully as efficient as argyrol, but, in efficient strength, more irritating.

Albargin.—Albargin is efficient, but somewhat more irritating than protargol.

ASTRINGENT ANTISEPTIC INORGANIC COMPOUNDS

The above clumsy title best describes a group of drugs that vary widely in usefulness and antiseptic power, but possess the common property of healing the inflamed urethra—a property only inadequately expressed by the word "astringent."

Astringent properties, in the chemical sense, are claimed for the organic silver compounds; but these exhibit very faint healing power when applied to the urethra.

Potassium Permanganate.—For the irrigation treatment of acute gonorrhea its virtues are exceeded only by those of the organic silver salts. It is our best remedy to hasten the cure of an active chronic urethritis. It equals nitrate of silver as a preventive of infection when sounds are passed or the prostate rubbed, as well as in the treatment of nonspecific and chronic urethritis. Yet it has its limitations. It achieves the best results when employed in weak (1:3,000 to 1:8,000) solutions and in large quantity, as an irrigation. As an injection for the anterior urethra it is distinctly inferior to many other drugs. In chronic urethritis that is almost healed it is inferior to silver nitrate instillation.

The statement often made, that while gonococci are present in the urethra silver salts should be employed, and after they have disappeared permanganate resorted to, is a misleading half truth. The organic silver salts are, it is true, pre-eminent as slayers of the gonococcus, but the inorganic silver nitrate and potassium permanganate are useful for all sorts of urethritis, except the most acute, whether gonococci be present or not.

Silver Nitrate.—On the general utility list silver nitrate stands equal to potassium permanganate. It has not served me well in the abortive treatment, and no one now uses it in advaneing acute gonorrhea, excepting as an instillation for hyperacute posterior urethritis.

It is useless for anterior urethral irrigation or injection. But for posterior irrigation it is as efficient as permanganate. Moreover, for instillation and urethroscopic application silver nitrate is used almost exclusively.

The pain excited by instillations of silver nitrate varies within the widest limits. Many a patient after receiving one instillation of 1:1,000 silver nitrate solution will never take another. Yet this is the strength at which we usually begin, and some patients grow so accustomed to it that the strength may be increased to as high as 10 per cent.

Silver Permanganate.—This salt is made by adding silver nitrate to potassium permanganate. To 500 c.c. of 1:8,000 solution of the latter I usually add from six to ten drops (minims) of a 10 per cent solution of the former.

I have found it useful only as a posterior irrigation in chronic cases, as an alternative for either of its components alone.

Mercury Oxycyanid.—The cyanate or oxycyanid of mercury is highly spoken of by European writers for the treatment of nongonorrheal urethritis. I have repeatedly tried it and found it relatively irritating and inefficient.

The Zinc Salts.—The zinc salts have been little used except as injections for the control of chronic anterior urethral discharges. (Yet zinc sulphate, in 5 per cent solution, makes an adequate bladder irrigation.) They rarely cure, but they control the discharge better than any other remedy and are thus of great assistance by the encouragement and sense of cleanliness they impart to the patient (but not, it is to be hoped, to his physician), while giving nature and the more efficacious local treatments time to effect a cure.

Zinc Sulphate is the most popular of these salts. It is usually employed in a 1 per cent solution or even stronger, though I fancy it is as efficacious in much greater dilution.

Zinc Acetate is more efficacious. I employ the following formula almost without variation. The combination throws down an insoluble zinc sulphate which helps to retain the acetate in the urethra.

℞ Zinci sulph..... 00.2 gm. gr. iij;
Liq. plumbi subacetat. dil...ad 100.0 c.c. ℥ iij.
M. Shake.
S. Inject b.i.d.

Zinc Permanganate is a hygroscopic salt and is, therefore, best kept in solution. At a strength of 1: 2,000 it is extremely efficacious; sometimes more so than the acetate. It is possible, but apparently unnecessary, to use it in much stronger solution.

Other Astringents.—The following composite preparations are recommended by various authors:

℞ Zinci sulphatis ..... gr. xv;
Plumbi acetatis ..... gr. xx;
Tr. opii. } āā ʒ ij;
Tr. catechu }
Aquae ..... ad ℥ vj.
(Brou.)

℞ Zinci sulphatis. } āā gr. jv. ad gr. xij;
Pulv. alum }
Acid carbolic ..... gr. jv;
Aquae ..... ℥ jv.
(Ultzmann.)

℞ Zinci sulphatis ..... gr. xij;
Resorcin ..... gr. xxjv;
Aquae ..... ℥ jv.
(Morton.)

℞ Cupri sulphatis ..... 0.20 gr. iij;
Alum crud. ..... 1.00 gr. xv;
Aquae ..... 200.00 ℥ vij.
(Kreissl.)

VEGETABLE ASTRINGENTS

The vegetable astringents are legion. Almost every known fluid, from hot and cold water to tea and claret, has been employed in the course of a gonorrhea that terminated in a cure. These remedies are only employed as injections in chronic or nongonorrheal urethritis as substitutes for the zinc salts. I am not enthusiastic over any of them.

The following are advised:

℞ Extr. hydrast. fl.[1] } āā ʒ vj;
Bismuth subcarb. }
Boroglycerid (25 per cent) }
Aquae destill. ..... ad ℥ vj.
(White and Martin.)

[1] The "colorless" preparation has been shown to be but a dilution of the colored drug. Hydrastis leaves an indelible yellow stain on linen.

℞ Ichthyol ..... gr. xx to ʒ jss;
Aquae .....q.s. ad ʒ jv.
(Baumann.)

℞ Berberine hydrochlorate ..... gr. v;
Aquae ..... ʒ viij.
(Belfield.)

OINTMENTS AND DRUGS

The application of urethral medication in an oily or greasy form has seemed to many an ideal way of treating chronic urethritis. Results have generally fallen below expectations. I have derived no advantage either from ointments or soluble bougies. Young,[1] who has reviewed the subject exhaustively, employs lanolin as excipient and uses the following formulae:

For cases with marked epithelial changes, salicylate acid (0.5 to 1 per cent).

For "less severe cases," iodoform (10 per cent), silver nitrate (1 to 2 per cent), or boric acid (10 per cent).

For cases with considerable glandular involvement, protargol (2 to 5 per cent), or bichlorid of mercury (1: 10,000), or formaldehyd (1: 5,000).

Janet, Caspar, Finger, and Bazy are among the other advocates of the method.

Formulae similar to the above are made up as suppositories, to be inserted into the anterior urethra. I have not found them as useful as injections.

[1] Johns Hopkins Hosp. Reports, 1906, XIII, 115.

CHAPTER XXIII

SYSTEMIC TREATMENT OF URETHRAL GONORRHEA

The efficacy of local treatment in repressing acute urethral gonorrhea leads many practitioners to forget the old "methodic" treatment, the sole reliance of our fathers. The methodic, or systemic, treatment of acute gonorrhea has indeed been relegated to second place; yet it is still important, not only when repressive local treatment is inapplicable, but also as an accessory to this local treatment. The hygienic and dietetic part of the treatment is of the utmost importance. If disregarded, the best directed efforts may miscarry.

CLEANLINESS

The parts should be washed as often as required, soap and warm water being as good as an antiseptic solution and more readily at hand. The discharge should be kept from smearing the underclothing. If the foreskin is long, the glans penis may be thrust through a slit in the center of a small square of gauze until the slit lies snugly behind the corona glandis; thus held in place, the gauze is folded forward over the glans penis, covered by replacing the foreskin, and left puckered up and long enough to protrude in a bunch in front of the preputial orifice.[1] If the prepuce is short, an apron of old cotton or linen doubled may be fastened to a string about the waist or pinned to a suspensory bandage, and the entire genitalia wrapped up in this; or one of the penis bags furnished by the shops may be employed.

Inasmuch as suspension of the testicles is advisable as a preventive of epididymitis, a "jockstrap" should be worn. This will act, incidentally, as a bag to contain the gauze or cotton garnishing the meatus.

Finally, the patient must be told the danger to his eyes from contamination with his urethral pus, and cautioned to touch the genitals as little as possible and to *wash his hands thoroughly with soap and water every time he has touched his penis.*

[1] The pledget of absorbent cotton, which is so efficient when the discharge is mild, retains the more profuse discharge in contact with the head of the penis, thus preventing proper drainage of the inflamed urethra.

DIET

The rigorous diet usually prescribed excludes all alcohol, spices, rich and indigestible sauces and foods, fruit, coffee, tea, and sparkling water. I have found it of no benefit to the patient's urethra to be so strict, and a great encouragement to his mind to permit a greater latitude. Alcohol, spices, and condiments must, of course, be prohibited, and it is well to specify ale, beer, cider, and ginger ale, besides insisting that any substance which burns the palate as it enters the body will burn the urethra as it issues forth (we speak, of course, of chemical, not of physical heat). Indigestion, whether from overeating or from indiscreet eating, is harmful, and acid fruits, especially lemons and grape fruit, as well as asparagus, are apparently irritating. But there is no reason to prohibit these absolutely nor to prohibit tea or coffee at all. I do not prohibit sparkling waters.

REST

Physical rest is most important. Were it possible for the business of the world to be transacted with all the sufferers from acute gonorrhea in bed, and were rest in bed not the very worst thing for the state of mind of these same sufferers, it would be wiser to place them all upon their backs. But, taking the world as it is, the best plan is to urge each patient to rest as much as may be; to ride rather than to walk, to sit rather than to stand. Railroad and automobile trips seem to be a peculiarly injurious form of locomotion.

SEXUAL HYGIENE

During the acute stage absolute continence is essential, and this should be extended at least two weeks after the cessation of all discharge, with the avoidance of anything liable to induce sexual excitement—association with women, racy books and pictures, erotic thoughts *et id genus omne.*

Such is the general rule; yet I have known patients accustomed to frequent sexual intercourse to be constantly distressed by painful erections unless they relieved their sexual tension by cohabitation (with a condom). Such license should nevertheless be absolutely prohibited. Massage of the prostate and vesicles cannot wholly replace it.

DILUENTS

The patient should drink (between meals if he is dyspeptic) about eight glasses of water a day. Ordinary drinking water suffices, but, if he can afford it and it does not prove too diuretic, an alkaline diluent, such as Vichy Celestins, is preferable.

But here again common sense must temper routine practice. In acute gonorrheal cystitis and in very acute posterior urethritis more harm may be done by the muscular straining attending the frequent repetition of the urinary act than is atoned for by any amount of dilution of the urine.

INTERNAL MEDICATION

The drugs that may be effectively exploited to combat acute urethral inflammation belong to five orders:

1. Urinary antiseptics.
2. Alkalies.
3. Demulcents.
4. Anodynes.
5. Balsamics.

1. URINARY ANTISEPTICS

Urinary antiseptics, such as hexamethylenamin, methylene blue, salol, benzoic acid and the benzoates, boric acid and the borates, have no recognizable influence upon urethral inflammation. Theoretically, they ought to be of paramount importance, but practically these substances, so valuable in suppurative conditions of the urinary tract above the bladder, are useless below that point, whether because their bactericidal efficiency is slight, or because their sojourn in contact with the inflamed urethral wall is limited, or because the bacteria are shielded from the antiseptic action of the medicated urine by the tissues in which they lie. The value of hexamethylenamin and of methylene blue in acute gonorrhea has been vaunted. In my opinion it is slight; so slight that it does not deserve consideration.

Yet hexamethylenamin is very useful to protect the kidneys. It should be given whenever there is an unexplained rise of temperature in the course of a gonorrhea.

2. ALKALIES

The virtue of alkalies in the treatment of urethral inflammations depends rather upon the condition of the urine than upon the grade of

the inflammation. The urine, normally acid and often dense, is, *ipso facto,* harmful except in so far as it washes the urethra, and the alkali is negatively a very good thing, but good only when required to counteract acidity. In other words, there is no specific action whatsoever in the alkalies. They do not in the least control suppuration. If one had two burned hands, and placed one of them in vinegar and water and the other in a watery solution of bicarbonate of soda, he would doubtless prefer the sensations experienced in the hand immersed in the mild alkali, and so it is with the urethra.

Patients having normally bland, alkaline, dilute urine (and there are many such) stand in no need of alkalies, and, indeed, may occasionally be injured by them, through indigestion.

When the urine is acid an alkali is indicated. If the urine be also dense a diuretic alkali is called for; if dilute (sp. gr. 1.015 or less), the diuretic quality is not needed.

Alkalies produce the greatest effect relative to the size of the dose, if administered toward the end of the second hour after eating.

Bicarbonate of Soda.—This is the mildest of the alkalies. Its chief virtue is that it aids digestion, while the other alkalies impede digestion more or less. Dose, 0.50 to 1 gram. It is prescribed in the form of tablets.

Sweet Spirits of Niter (spts. etheris nitrosi).—Sweet spirits of niter is notable for its anodyne rather than its alkaline properties. It is chiefly employed for the slight irritation of the bladder so common in women. Dose: 2-6 gm., in water.

Potassium Citrate, Potassium Acetate, Liquor Potassae.—These three salts are employed more than any others as urinary alkalinizers. The citrate is the most efficient as an alkali, but irritates some stomachs, the liquor the most anodyne, the acetate the most diuretic. Therefore the liquor is most useful in acute cases, and the citrate in chronic cases. The acetate is a stronger diuretic than the citrate, but I have found it also more irritant to the stomach. The dose of each drug is about 0.5 gram in a considerable quantity of water. The disagreeable taste is well disguised by syrup of cinnamon.

Bromid of Potassium.—This acts as an alkali and is sometimes efficient in controlling the smarting upon urination.

3. DEMULCENTS

Demulcents are much less used now than formerly, but may be comforting when combined with an alkali. To this class belong flaxseed tea, gum water and elm-bark water, the various fluid extracts made from buchu, pareira brava, uva ursi, triticum repens, and corn-silk.

4. ANODYNES

Anodynes are called for to moderate pain on urination, and for this bromid of potassium or the tincture or fluid extract of hyoscyamus generally suffices. A favorite old-fashioned prescription is:

℞ Liq. potassae	8.00-25.00 gr.	ʒ ij-vj;
Tr. hyoscyami	15.00-35.00 gr.	ʒ ss-j;
Syr. cinnamon .....q. s. ad	100.00 gr.	ʒ iij.

M.

Sig.—Teaspoonful in water two hours after each meal (or oftener).

For Intense Chordee.—Lupulin in doses of 2 to 4 grams taken upon retiring is sometimes effective, or a similar dose of the bromid of potassium. The coal-tar products are useless, codein feeble, opium risky. Hot water is a good preventive, cold water a quick relief (as stated below). The patient should sleep lightly clad in a cool room.

For Painful Urination.—The anodyne mixture given above is excellent. Codein or bromids may be added for a severe case of acute cystitis. It is an advantage to instruct the patient suffering from this complication not to empty his bladder completely, but to let the last of the urine dribble away without the aid of the distressful piston stroke. The instruction is hard to follow, but it may afford great relief. The uses of water in this connection are mentioned below. The rôle of the prostate must not be forgotten, and if all else fails, local treatment (p. 235) or even operation may be resorted to.

Hot Water is of value in various ways. When the pain on urination is intense it may be somewhat moderated by immersing the penis in very hot water and urinating into it. Prolonged soaking of the penis, just before retiring, in water as hot as can be borne, will often prevent or moderate chordee during the night.

A Hot Hip Bath is full of comfort for the patient with any form of acute prostatic, vesical, or seminal vesicular inflammation. Such a bath may be repeated every few hours. It should be short, not lasting more than five minutes. The temperature of the water at first should be near 104° F., and after the patient is in the bath more hot water should be added until the temperature is as high as he can tolerate.

The Hot Rectal Douche (p. 209), once or twice a day is even more efficient.

Iced Water is useful when the penis is erect and in chordee. The patient naturally urinates at once, if he can, and then by pouring iced water over his turgid and unruly member, or by placing it alongside a cold piece of metal, he strives to reduce it to subjection. To break a chordee is to invite stricture.

5. BALSAMICS

Some form of balsamic should be administered throughout the acute stage of gonorrheal urethritis. It may or may not be obviously beneficial in a given case, but it is never harmful if the single rule is observed, that the medicine should never disagree with the patient's digestion. In order to benefit the urethra it should not upset the stomach.

The products of the synthetic laboratory, such as gonosan (two capsules three times a day), arrhovin (same dose), or santyl (same dose), are perennially hailed as a prodigious advance over the old crude method of balsamic medication. Careful trial of the drugs cited has not convinced me that they are any more or any less potent than the more familiar drugs contained in the capsules compounded by American firms.

Among the older balsamics oil of yellow sandalwood, balsam of copaiba, cubeb, and oil of wintergreen are the only ones of proven value. Eucalyptol, kava-kava, matico, pichi, and many others are variously rated, but are not generally employed.

If sandalwood oil in small quantity gives a man so severe a pain in his back that he can neither exercise nor sleep, and if copaiba in moderate doses so upsets his stomach as to produce nausea, or if he easily gets copaibal erythema, he certainly cannot derive proper advantage from these drugs, and it is folly to push them. But, on the other hand, when the balsams agree they are exceedingly helpful, and their dose may be pushed with advantage up to the limit of satisfactory digestion.

Sandalwood Oil.—The preparation made from yellow sandalwood is probably better than that made from the red, but both have merit. It is prescribed after meals in capsules, containing 5 and 10 minims (and in all sorts of combinations with other balsams and with salol, with pepsin, etc.).

The dose of sandalwood oil should be at least 0.7 gram (10 minims) three times a day. (It may be pushed to 2 grams (30 minims) four times a day; though rarely is so much required.) Even the lowest dose sometimes upsets digestion or gives the distressing *pain in the back,* which calls for a diminution in dose or a change of drug.

If a liquid be preferred to a capsule the alkali and balsam are easily combined.

℞ Potass. citrat. (or hydrat.)	8.00-25.00	gm.	ʒ ij-vj;
Ol. santal	15.00-25.00	gm.	ʒ jv-vj;
Syr. acaciae	30.00	gm.	ʒ j;
Aquae menth. pip. q. s. ad	100.00	gm.	ʒ iij.

M. Shake.

Sig.—Teaspoonful in water two hours after eating.

Copaiba.—This may be prescribed (4 to 10 grams) instead of sandalwood oil in this combination late rather than early in the disease, and fluid extract of hyoscyamus or deodorized tincture of opium if required as an anodyne.

This dose is easier to take than the time-honored Lafayette mixture—Heaven knows why that warrior allowed his name to become attached to such a compound!—and the citrate of potash seems to do better work than the niter of that mixture. Bicarbonate of soda may substitute the citrate of potash when a diuretic effect is not desired, and wintergreen or licorice flavors be substituted for the mint. Copaiba more than sandalwood oil, however, demands the capsular form of administration. It often nauseates, sometimes occasions diarrhea.

Copaibal erythema consists in the appearance of closely aggregated, slightly elevated, itching, red blotches scattered over the whole trunk. It is easily cured by a discontinuance of the drug, an alkaline laxative, a few warm bicarbonate of soda baths.

Cubeb.—This is a stimulant as well as a balsamic. It agrees with most stomachs, but in large dose sometimes irritates the bladder slightly. Hence, it is more applicable to the declining than to the advancing stage of urethral inflammation. The powder is often spoken of, but rarely given, in this country. The fluid extract is better, in half teaspoon to teaspoonful doses, hot; the oleoresin, in capsules, perhaps best in the dose of 0.3 to 1 gram (5 to 15 minims) (1 to 3 capsules).

Wintergreen Oil.—This or its synthetic substitute, methyl salicylate, is given in 0.7 gram (10 minim) capsules, one or more at a dose.

Kava-kava.—Fluid extract of kava-kava in 0.5 to 2 gram doses is, apparently, sometimes helpful.

The balsamic remedies have been found ineffective when injected locally. They undergo a change in passing through the kidney. The excreted urine exercises a local action [1] upon the inflamed surface of the urethra; consequently the balsams are useless in female gonorrhea, unless the urethra or bladder be involved.

INSTRUCTIONS TO PATIENTS

Of late years the commendable practice has arisen of distributing to dispensary patients, suffering from venereal diseases, a card indicat-

[1] As has been proved when large fistula in the floor of the urethra permitted the urine to be turned off, the part behind the opening getting well first, and the anterior urethra being subsequently cured by injection with the patient's own urine, freshly passed and full of modified copaiba. I do not know that this has been demonstrated except for copaiba; and yet Steinschneider and Schaeffer (cited by Sée) found that the urine of patients who had taken copaiba did not show bactericidal qualities.

ing the chief dangers of the disease and the precautions they personally must take to encourage speedy cure and to protect their fellows. The following list has been approved by the Associated Clinics of New York City:

INSTRUCTIONS TO THOSE HAVING GONORRHEA

You have a serious contagious disease. It may continue for years after the discharge ceases and you seem well. Therefore you must not marry or have any sexual relations until a reputable physician has pronounced you cured.

A woman with this disease may become sterile, or be an invalid for life, or have to undergo a very serious and mutilating operation. A child born to a woman with this disease is likely to become blind.

For your own protection, and the protection of others, observe the following precautions:

1. Always wash the hands after handling the parts; the discharge, if carried to the eyes, will make you blind.
2. Sleep alone, and be sure that no one uses your toilet articles, particularly towels and wash cloths.
3. Never lend your syringe to anyone, and as soon as you are well, destroy it.
4. Avoid all sexual relations and excitement.
5. Be sure that the bowels move every day. If constipated, take a laxative.
6. Do not use alcohol in any form, as it always prolongs the disease.
7. Drink from six to eight glasses of water a day.
8. Avoid all spicy food and drink, as ginger ale, mustard, pepper and horseradish.
9. So long as the discharge is free, walk as little as possible.

GENERAL TREATMENT OF CHRONIC URETHRITIS

General Hygiene.—Many of the general hygienic rules for the treatment of acute gonorrheal urethritis do not apply to the treatment of chronic inflammations. Thus the *diet,* which should be light during the acute period of the disease, should be rather full and stimulating in the chronic stages. *Exercise,* which is always harmful in acute gonorrhea, is often beneficial to a chronic case. Exercise should not only be permitted, but should be encouraged. There is no reason to prohibit even such violent pastimes as tennis and swimming, to a patient suffering from chronic urethritis; *but they should be begun gradually,* and the patient should feel his way, taking more and more exercise as he assures himself that it does him no harm.

The intelligent use of *alcohol* is one of the most thoroughly misunderstood points about the treatment of chronic urethritis. Although we realize that many of the drugs and methods of local treatment employed for chronic urethritis are used chiefly because they are irritating, yet we forget that alcohol is one of the best known urethral irritants, and

we are too much inclined to scoff at the story of the patient who, despairing of a cure after many months of treatment for his local urethritis, breaks training, enters a wild debauch, and comes out of it cured. Such a case is not the exception that proves the rule, but is only an illustration of the rule that what we seek for the cure of chronic urethritis is the proper irritant, and alcohol sometimes fits the case. *Alcohol is almost universally harmful so long as gonococci can be found in the urethral pus* (though there are rare exceptions even to this rule); but after the gonococci have disappeared, if the patient is an habitual drinker, it is proper to urge him to return gradually to the use of alcohol, and such a course frequently has a most beneficial effect, both upon the patient's mind and upon his catarrh. It is an exhibition of intelligence on the part of the physician to cure his patient by giving him whisky to drink, rather than to run the risk of permitting the patient to make this experiment for himself.

Other hygienic measures, such as sending a patient away from the city to the country, or bidding him change his climatic conditions by a trip at sea or to the mountains, are very rarely called for. Yet, when local measures fail after a thorough trial, it is imperative that the patient leave his work and his home to take a vacation. Under such conditions a brief trip may well effect cure, or at least put the patient in such a condition that local treatment, which previously was ineffective, will now prove curative.

Sexual Hygiene.—While gonococci persist sexual intercourse is as likely to reinfect the gonorrheic as it is to infect his partner. But after their disappearance it is likely to do good by relieving the sexual congestion of one who is (presumably) accustomed to frequent sexual intercourse. The irritation of ungratified sexual desire, the effort to check the sexual habit, is to many gonorrheics the most distressing feature of the disease.

Drugs.—Most cases of chronic urethritis may be treated successfully without any internal administration of drugs. Very exceptionally a patient is benefited by the internal administration of balsamics or alkalies. More commonly, a brief, severe course of water drinking will cure a mild catarrh by flushing the canal. The alkaline mineral waters are, apparently, the best suited for this purpose. Urotropin is employed as an antiseptic preliminary to the use of sounds or dilators, and for the treatment of pyelonephritis or bacteriuria. Alcohol should be used intelligently, as stated above. Tonics may be required.

CHAPTER XXIV

LOCAL TREATMENT OF ACUTE GONORRHEA

The local treatment of acute gonorrhea comprises five entirely distinct subjects, viz.:

The preventive treatment.
The abortive treatment.
The repressive treatment.
The terminal (expectant) treatment.
The treatment of complications.

THE PREVENTIVE TREATMENT

The man who practices promiscuous cohabitation sooner or later catches gonorrhea in spite of every precaution. The condom is still "a cuirass against pleasure, a cobweb against infection," as Ricord used to say. The condom may tear and so admit infection; and once in a great while one is consulted by a victim who alleges he was infected in spite of its protection. The infection in such cases doubtless results from preliminary skirmishing.

Some measure of safety is afforded by urination and thorough washing with soap and water immediately after cohabitation. To this any one of the following therapeutic measures adds a far greater assurance of safety:

Instillation into the meatus of a few drops of 20 per cent argyrol or 5 per cent protargol.

Irrigation of the anterior urethra with permanganate of potassium (1:1,000).

Injection and retention for five minutes of 20 per cent argyrol or 1 per cent protargol.

The safety afforded by any of these is approximate but not absolute. The treatment should be employed within twelve hours of the contact and should not be repeated. A traumatic urethritis, lasting a day or two, may result.

THE ABORTIVE TREATMENT

In the production of chronic urethritis the abortive treatment has taken the place of the sound of our forefathers.

In exceptional cases it is possible to abort gonorrhea. Indeed, in some cases gonorrhea almost aborts itself. But *it is almost impossible to abort a first gonorrhea,* and often impossible to abort subsequent attacks. After experimenting with every method of aborting gonorrhea I ever heard of, it is my present conviction that *the surest way to abort gonorrhea is not to try to abort it.* The repressive treatment every now and then results in a rapid cure. Last winter I had the pleasure in a single week of curing three cases of acute true gonorrhea, two of them within seven and a third within twelve days of its inception. But I treated no two of them alike; they were all secondary gonorrheas. I made no attempt to abort any of them, and in the six months since that time I have cured but one case within four weeks.[1]

Bierhoff [2] reviews the opinions of various authorities, and claims 50 per cent cure for the following modification of the method of Frank and Lewin (who report 45 per cent cures):

A microscopical examination of the secretion was first made. If the discharge was slight, and if the majority of the gonococci still were extracellular, then the protargol solution was employed in the strength of 1-6 to 1-3 per cent. If the discharge was at all pronounced, or if the greater part of the gonococci were intracellular, then a 1-3 to 1-2 per cent solution was used. The method was employed, naturally, only in those cases in which the second urine was clear. After urination, the urethra was anesthetized by an injection of a mixture of 4 c.c. of a 1 per cent cocain solution and 4 c.c. of a 1 per cent protargol solution. After this the anterior urethra was cleansed with 150 c.c. of the protargol solution. Following this, an irrigation of the whole urethra was made, according to Janet's method, with 150 c.c. of the solution. The patient then emptied his bladder of the irrigated fluid. This irrigation of the entire urethra, with immediate emptying of the fluid, was repeated from one to three times in the same sitting, so that the urethra was flushed four to eight times. In addition, the patient was given a solution of protargol, ½ per cent, with which he was instructed to inject three to five times during the day, and to retain the fluid ten minutes each time. During the succeeding days, if the gonococci had disappeared, the strength of the solution and the quantity of fluid injected were diminished, to be suspended, if the result was positive, on the fourth or fifth day, at the latest. The injections by the patient were also diminished and suspended in a similar manner. Then followed the usual provocative tests and control examinations.

Kreissl employs the following treatment for every case of acute urethritis of less than two days' duration:

After irrigating the anterior urethra with a hot boric acid solution a constricting rubber band should be placed around the penis at the penoscrotal junction, and one dram of a 4 per cent protargol solution injected and retained for five minutes. For irrigation with the boric acid solution a piston syringe and a sterile

[1] This paragraph was written in 1910. My conviction remains unshaken today.
[2] *Med. News,* 1904, lxxxiv, 488.

elastic catheter should be used. No pressure to distend the urethra should be applied and the fluid should commence flowing through the catheter before it enters the urethra, whereby the dissemination of infectious material is avoided.

During the following eight days the anterior urethra should be irrigated in the same manner with a pint of a 1:3,000 hot nitrate of silver solution, once a day. The discharge, if there be any, is examined microscopically every day. If no gonococcus be present in the last five specimens, the treatment may then be discontinued; otherwise, the systematic treatment for gonorrheal urethritis should be commenced.

Excellent results are also attributed to permanganate employed in the routine way as described below.

REPRESSIVE TREATMENT

The repressive treatment of acute gonorrhea consists in the employment of local treatment calculated to control the inflammation; but with the prime object of lessening the symptoms, the complications, and the prospects of chronicity, not of cutting short the acute attack. The systemic treatment described in Chapter XXIII is always employed. Repressive treatment occasionally and quasi-accidentally results in abortion of gonorrhea. Indeed, I believe it so results quite as often as the abortive treatments detailed above, while it has the supreme advantage of leaving those cases that are not aborted soothed rather than irritated and in the best possible condition to weather the weeks to come.

Cases Suitable to Repressive Treatment.—The physician unfamiliar with the local treatment of urethral disease can expect but little success with the repressive treatment of gonorrhea. The expectant treatment will give him better results.

The physician moderately familiar with the subject should undertake this treatment with fear and trembling. He should apply it at first only to cases that he can absolutely control, who apply for treatment during the initial stage of the disease, before the meatus is much swollen, the discharge free, the "second" urine cloudy, or pain on urination or erection present. This admits most cases from one to three days old.

The expert will determine how far his personal success permits him to disregard the above rules. None of them are absolute to him, so long as he proceeds gently and is in no hurry to get the patient well.

Choice of Repressive Treatment.—There are two entirely distinct types of repressive treatment, viz.: injection of organic silver salts and irrigation with potassium permanganate. Certain practitioners employ them simultaneously. In my experience the silver salts have proven

distinctly superior to the permanganate (which I used exclusively for three years), and are most efficacious when used alone. Permanganate reduces the inflammation much more rapidly and clears the urine far more brilliantly than the silver salts, but gives a much larger proportion of chronic gonorrheas.

ORGANIC SILVER SALTS

A Routine Treatment.—I usually employ 0.5 per cent protargol. The patient, after urinating, injects this into the urethra at least three, at most four, times a day. The intervals are made as even as possible, and no interval of less than three hours is permitted. The injection is retained five minutes *by the watch,* unless this excites pain, in which event the duration may be reduced to even three minutes (or the strength of the solution diminished).

The test of the success of repressive treatment is diminution and disappearance of the patient's subjective symptoms (pain or discomfort). The patient must be impressed with the fact that the success or failure of the treatment is in his hands, and that *the sign of danger is pain,* the cause of pain trauma. He must be gentle in injecting, gentle in compressing the meatus, and should not repeat an injection in case a first effort fails.

Pain is never the same in any two cases. To say that an injection of protargol to be efficient should be painless, is obviously untrue. But *each successive injection should be less painful than its predecessor, and the appearance of any new or increased pain at any time is the one signal that calls for immediate consultation.*

The patient reports every day or every other day for the first week and but twice a week thereafter, until in the fourth or fifth week the time for terminal treatment arrives.

If all goes well, the discharge disappears in a few days. The first urine becomes almost clear, but never quite sparkling. The second urine remains sparkling. There are no subjective symptoms.

In from five to ten days there is often a sudden change for the worse. The discharge increases, the urine becomes more purulent, there may be some swelling at the meatus, and pain on urination and injection. This indicates either that the urethra is irritated by the injections or that the gonorrhea is escaping control. Injections should, therefore, be completely stopped. Twenty-four hours later the patient reports:

1. If the symptoms have diminished and no gonococci are found, no injections are given and the patient reports daily, each day carrying home two slides to be smeared with the morning discharge and examined for gonococci. So long as he continues to improve and gonococci do not appear, no more local treatment is given. If the urine remains spar-

kling for four days the patient is probably cured. He is dismissed for three days and the cure verified in the usual way (p. 192).

2. If the symptoms have diminished but gonococci reappear, the treatment by injection is resumed.

3. If the symptoms have increased or remained stationary, gonococci will almost invariably be found. The decision whether or not to abandon the repressive treatment now depends upon the patient's condition. He should be treated as though this were his first visit, by injections or by expectant treatment.

At the end of the third or fourth week an anterior injection of zinc acetate may be substituted for one of the silver injections every day or every other day. He shall be carefully instructed *not* to retain this in the urethra.

This brings us to the terminal treatment (p. 232).

If the Case Is Seen Late.—If the case is not seen until it is well under way, local treatment will, of course, be begun very gingerly, using 0.25 per cent protargol for two or three minutes only for the first day or two, until the sensitiveness of the urethra abates sufficiently to permit of stronger and longer injections. Or 10 per cent argyrol may be employed.

Treatment of the Posterior Urethra.—The urine, passed in two glasses, is carefully examined at each visit. The first appearance of haziness (due to pus) in the second urine passed shows involvement of the posterior urethra. It must then be treated in the following manner:

If the anterior urethritis is not very well controlled, no treatment of the posterior urethra is required at the first appearance of pus in the second urine. Local treatment of the anterior urethra is continued, and if this promptly brings the anterior inflammation under control, the posterior urethra is attacked as described below. If the anterior urethritis is not controlled before the posterior urethra begins to show subjective symptoms (frequent and painful urination), the physician must elect one of two courses, in accord with his prospect of success. If the anterior urethritis is quite uncontrolled the repressive treatment should be abandoned; if there is still prospect of controlling it, the posterior urethra should be attacked, as described below. When in doubt stop all local treatment.

If the anterior urethritis is well controlled when pus first shows in the second urine, the posterior urethra should be promptly attacked with instillations once or twice a day of 20 per cent argyrol, or 0.5 per cent protargol, 1 c.c. to a dose; or by posterior irrigation (very small catheter or very gentle force) with protargol (1:2,000), argyrol (1 per cent), or permanganate (1:8,000), once a day.

The selection of treatment for the posterior urethra depends upon

the experience of the physician and the previous history of the patient.

If the posterior urethritis begins to show symptoms in spite of this treatment, the patient may be put to bed, hot sitz bath or rectal douches administered twice a day, and the treatment continued. If the symptoms still progress, or if the patient is unable to rest, all local treatment should be discontinued, and the case treated as one of acute posterior urethritis.

When Treatment Fails.—If pain does not diminish with repeated injections, or if posterior urethritis becomes uncontrollable, all local treatment must be stopped. The occurrence of balanitis or lymphangitis does not call for cessation of local treatment. But periurethritis does.

Other Methods of Treatment.—To develop a system of repressive treatment for acute urethral gonorrhea takes a year or more of personal experience. During that time one's practice incessantly varies, and, having developed a system, the variation continues. New impressions are received from each case, and scarcely any two cases are treated in the same way. Therefore the practice of no two men can positively agree.

Kreissl says:

> Inject ⅛ per cent solution of protargol and retain it for one minute, repeating the treatment every two hours during the day and twice during the night.
>
> After three days a ¼ per cent solution should be injected every three hours during the day and once during the night. At the end of the first week the strength may be increased to ½ per cent, to be injected every four hours and retained for five minutes, while the night injection may be discontinued. At the beginning of the third week the same solution may be injected three times a day and retained for five minutes at a time. At the beginning of the fourth week, when the secretion will be found to contain mostly epithelial cells, no, or but a few, leukocytes, and no gonococci, an astringent and mild antiseptic may be substituted for the morning and noon injection with protargol, but the latter should still be used before retiring.

Finger employs 0.25 per cent protargol solutions, warm, and always precedes injection by a gentle irrigation with water to wash away the urine that remains in the canal. He insists that the injection syringe should contain at least 10 to 12 c.c. He retains the fluid at least five minutes and expects it to reach the posterior urethra. He injects three or four times a day. After three or four days he increases the strength of the protargol to 0.5 per cent, then to 2 per cent. Then, in the second week, he begins with largin, 0.25 per cent, and within two weeks increases the strength of this to 1 per cent, meanwhile diminishing the frequency of injection to once a day, substituting Ultzmann's astringent injection (p. 214) twice a day.

POTASSIUM PERMANGANATE IRRIGATION

Janet's Method.—Janet devised the permanganate irrigation treatment for acute urethral gonorrhea. He introduced neither the drug nor the method. But he combined the two in a practical system. His instruments are sold in this country under the name of Valentine, and his method is often incorrectly spoken of as Valentine's method. Janet irrigates the posterior urethra by gravity, without a catheter.

He irrigates the anterior urethra twice a day for three or four days, then increases the interval from twelve to eighteen hours. When the cloudiness of the first urine is pretty well gone, he makes the interval twenty-four hours. When the discharge is no longer purulent, he makes it forty-eight hours.

When the second urine becomes cloudy, he irrigates the posterior urethra according to the same method, twice a day at first, later every day or every other day. For each irrigation, of anterior or posterior urethra, he employs 500 c.c. of fluid, at a temperature of 110° F.

If the case is seen before the appearance of marked inflammatory symptoms, he employs a 1 : 500 solution of permanganate, immediately followed by a like quantity of boric acid solution. If this does not prove too irritating, he continues at this strength until the inflammation has subsided sufficiently to permit intervals of thirty-six to forty-eight hours, when he drops to 1 : 4,000 or 1 : 6,000 permanganate and omits the boric acid.

If the posterior urethra becomes inflamed, he begins irrigating it with solutions of 1 : 4,000 down to 1 : 10,000. If these are well borne, he increases the strength to 1 : 2,000 or 1 : 1,000, and follows it with a boric acid irrigation.

If the patient is first seen after the appearance of acute inflammatory symptoms, the irrigation is begun at 1 : 10,000 to 1 : 4,000 strength, and only for the anterior, even if the posterior urethra is inflamed. He begins treatment of the posterior urethra only when the anterior inflammation is under control.

In the declining stage he gives a daily irrigation of 1 : 6,000 to 1 : 8,000.

Other Methods.—Valentine and the other followers of the Janet method in this country follow his method with certain variations. They usually employ much weaker solutions (1 : 4,000 to 1 : 20,000) and larger quantities (1,000 c.c. or more), and often irrigate the posterior urethra every day or every alternate day as a routine measure.

Results.—Janet claims a cure within three weeks for most cases seen early,[1] and Valentine says[2]: "No other method can show 90 per cent

[1] Cf. Monograph in Oberlaender, *Chr. Gonorrhoe d. Manl. Harnrohre,* 1905.

[2] "The Irrigation Treatment of Gonorrhea," 1899.

of cures in fourteen days." Yet the method which was almost universally tried ten years ago has now quite fallen into disrepute. I can add one more voice to those assembled in protest by Horwitz.[1]

I cannot even say that I have found it useful in conjunction with the silver salts, until the acute inflammation has been controlled. But in the terminal treatment it is a most valuable remedy.

THE TERMINAL (EXPECTANT) TREATMENT

The *terminal* and *expectant treatments* of acute urethral gonorrhea are not precisely the same thing. The expectant treatment consists in employing no local repressive measures, letting the disease run for three to four weeks until it begins to abate, and then applying local measures. Terminal treatment includes all measures applied during the stage of decline, whether the case has been through an expectant or a repressive course.

Terminal treatment, therefore, begins in the third to the fifth week of the disease in two classes of cases, viz.: those that have been controlled, but not cured, by repressive measures, and those that have begun to abate spontaneously.

Precisely when to begin terminal treatment in either event must depend upon the judgment of the physician, founded on his previous experience.

If the case has been treated expectantly, terminal treatment is begun according to the method used for repressive treatment. By this the symptoms are very promptly controlled, and within a week or so the case is usually ready for actual terminal measures.

Terminal treatment begins with examination of the prostate and vesicles, even if the second flow of urine is and always has been clear.

The patient urinates to clear the anterior urethra of pus, but retaining a little urine in the bladder. The prostate and vesicles are then gently massaged, a small catheter gently introduced, and the first urine passing through this caught and examined for pus. If this is found (by microscope), the case is treated as one of prostatitis or vesiculitis (p. 235); if not, as one of urethritis. In any case, this examination is concluded by a bladder irrigation with 1: 8,000 potassium permanganate.

Thereafter the patient continues to use anterior injections himself and returns to the physician for treatment of the posterior urethra.

Treatment of the Anterior Urethra.—The patient uses an injection twice, rarely thrice, a day. If the discharge contains gonococci, this injection should be antiseptic (usually protargol, 0.5 per cent); if not, astringent (zinc salts). Such is the general rule; yet it is always

[1] *Therap. Gaz.*, March, 1903.

well to experiment with astringents, even in gonococcic cases. Order one astringent injection a day in addition to two antiseptic ones; if this diminishes the discharge or clears the urine, the astringent may replace the antiseptic still further. Indeed, it is not uncommon for gonococcic cases to do better under an exclusively astringent local treatment. Nongonococcic cases, on the other hand, may do well for the first week or two under argyrol or protargol.

Treatment of the Posterior Urethra.—If the case is progressing satisfactorily to a cure under anterior injections, no treatment of the posterior urethra is required. But if there is a halt in this progress, as judged by the two-glass urinary test, or if prostatic massage reveals prostatitis, or if the second flow of urine is slightly purulent, treatment of the posterior urethra should be begun by posterior irrigations once a day or once every alternate day, combined with the treatment of prostatitis, if this is present.

The frequency and the nature of the irrigation varies according to the idiosyncrasies of each case. Permanganate in weak (1:6,000 or 1:8,000) solution is the most generally efficacious, silver nitrate and silver permanganate stand second. If irrigations irritate, instillations must be employed. If this treatment fails to cure in a few weeks, the case must be considered chronic and treated accordingly.

TREATMENT OF COMPLICATIONS

Abscess of the Urethral Glands.—Acute relapse or chronic prolongation of gonorrhea because of infection of the glands or of the paraurethral ducts is a matter for treatment in the chronic stages of the disease; nothing can be done while the whole urethra remains acutely inflamed.

Periurethritis.—Stop repressive treatment.

All pus formations about the urethra, whether diffuse or circumscribed, are treated during the acute inflammatory stage on general surgical principles—by rest, protection from friction and injury, moist weak bichlorid or mild carbolized wet dressing under gutta-percha tissue. Incision is required as soon as the abscess is as large as a pea, if not sooner. When the abscess projects internally and not externally, an attempt should be made to open it from within through a urethroscope.

When permanent fistula results it should be treated by Chetwood's method, viz.: the injection into the urethral end of the fistula of a 25 per cent ethereal solution of peroxid of hydrogen, using a fine-drawn, rubber-capped, glass pipette (Fig. 45) with bent extremity.

By means of this instrument, aided by a wire speculum, a few

drops of the solution are thrown into the fistula. This is repeated every three days until the fistula closes. This treatment should be applied from within the urethra, the internal orifice of the fistula being enlarged for that purpose, if necessary. Fistulae that do not yield to this treatment require a plastic operation.

If little shotlike bodies remain under the skin, refusing to suppurate actively, these may be excised, but fistula may result.

Spongeitis and Cavernitis.—*Chordee,* the commonest evidence of inflammation in the corpus spongiosum, is a contra-indication to repressive treatment. If the erections are rendered more painful by the injections, these must be stopped. Chordee is self-limited. It usually ceases in ten days. To prevent chordee the patient should eat and drink

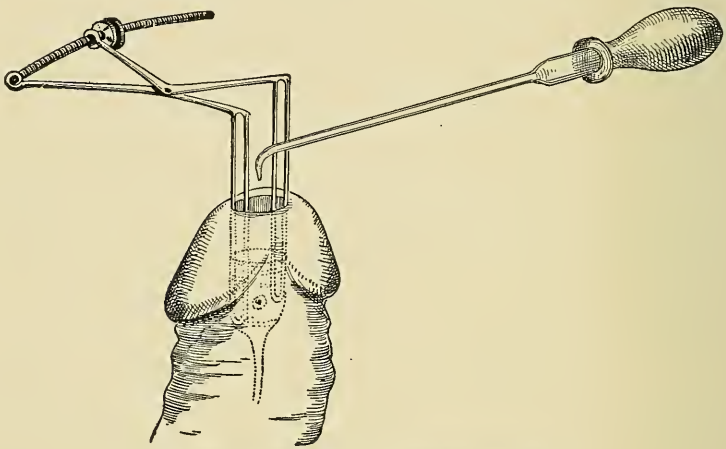


Fig. 45.—Injection of Urethral Fistula.

little in the evening, avoid all sexual associations, sleep under light covers, and arise to urinate in the middle of the night. To palliate it he should bend the erect penis gently downward and check the erection by immediate urination, or by first plunging the penis into cold water and then urinating. Prostatic massage has been suggested as a means to reduce the sexual tension and so prevent erections. I have not found it of any service, though one occasionally sees an amorous patient in the declining stage of acute gonorrhea benefit by sexual intercourse.

The rare, true spongeitis or cavernitis is treated by rest and cold or heat, until resolution occurs or abscess requires incision.

Balanoposthitis, Lymphangitis.—These are treated in the usual way (pp. 645 and 647).

Paraurethral Canals.—Inflamed paraurethral canals or pouches should be slit up as soon as they are recognized, unless the anterior urethra is acutely inflamed at the time.

Acute Posterior Urethritis and Cystitis.—Under this title we consider the treatment of cases of posterior urethritis unaccompanied by palpable change in the prostate, and too severe to be controlled by routine treatment of the posterior urethra (p. 171).

In such cases all local treatment of the urethra must be abandoned. The patient is persuaded to rest as much as possible, in bed if the pain is very severe. Some sedative, such as the liquor potassae and tr. hyoscyami mixture, is administered. The bromids are, next to opium, the best sedatives; they may be added to the above mixture.

To alleviate pain I usually advise the constant application of a hot-water bag to the perineum, and a sitz bath of five minutes in water as hot as can be borne, to be taken twice a day, or, if it gives great relief, before each micturition. Some patients prefer to urinate in the bath. Hot rectal douches, very gently administered, not oftener than twice a day, may sometimes be substituted with advantage for a sitz bath, but they may irritate more than they soothe. Sedative suppositories of opium and other drugs are singularly inefficient. Such drugs are more effective and under better control if given by mouth.

If incessant pain continues or grows worse under this treatment, and the absence of fever or complete retention, or of a prostate palpably inflamed, shows that there is no marked prostatitis, the inflammation may be directly attacked (after local anesthetization of the urethra) by instillation of two or three drops of 5 to 10 per cent silver nitrate solution. The instillation should be administered with the utmost gentleness in the posterior urethra.

The injection may be repeated in greater or less strength every two or three days. Twenty per cent gomenol or 10 per cent argyrol are, I believe, not quite so efficacious as the silver salt.

The effect of the injection is often a marked diminution in the pain. As soon as this occurs local treatment is stopped until the symptoms have considerably ameliorated, when it is resumed as in the terminal treatment (p. 232).

If pain persists in spite of instillations, the case is treated as one of acute prostatitis.

Acute Prostatitis and Prostatic Abscess.—In Chapter XVII, we have shown the futility of attempting to distinguish clinically between acute prostatitis and prostatic abscess.

The treatment of this condition is prophylactic, palliative, and operative.

Prophylactic Treatment.—The treatment of acute prostatitis, to be truly successful, should begin before there is any abscess, even before there is any prostatitis; it should be preventive. To prevent acute prostatitis the most important precaution, apart from gentleness in all urethral instrumentation, is a great respect for the urethra during

acute gonorrhea. Prostatic abscess is nowadays more often caused by intemperate use of the so-called abortive treatment of gonorrhea, whether injection or irrigation, than by anything else. In only one of my first five acute gonorrheal cases had the patient *not* been taking an "abortive" course, while of the four whose abscess was directly due to such a course three were married men upon whom argyrol (2) or permanganate (1) had been vigorously employed in the vain hope of curing the disease in a few days.

Palliative Treatment.—The palliative treatment is much the same as that of acute posterior urethritis.

If there is acute retention, a small (15 F.) soft-rubber catheter should be introduced three or four times a day, and followed by a mild antiseptic irrigation until retention is relieved, though if spontaneous urination is not established within a day or so, or if catheterism is difficult or painful (because of stricture or inflammation), one should operate at once.

To sum up, the palliative treatment consists of:

1. Stopping all urethral treatment.

2. The administration by mouth of some soothing urinary antiseptic with whatever sedative and laxative may be necessary.

3. Insistence upon the general rules of antigonorrheic treatment, especially as to physical rest; rest in bed, if there is fever.

4. Hot sitz baths or hot rectal douches, with the hot-water bag as local sedative.

5. Catheterism and bladder wash if there is complete retention.

As a result of this treatment we look for prompt relief of two symptoms, viz., fever and retention.

If the patient's temperature does not within a few days fall to and remain below 100° F., and if acute complete retention is not almost immediately relieved, the abscess should be promptly operated upon.

Such a rule may seem unnecessarily severe, even brutally surgical, for it takes no account of the precise pathological conditions within the prostate. Yet it is fully as justifiable, fully as necessary, as the rule to operate early in acute appendicitis. In each disease unexpected cure without operation may follow a long and distressing illness. But such a cure is not to be compared with the immediate relief following upon operation, while the entire safety of such an operation, if promptly and properly performed, contrasts strikingly with the miserable and even fatal results of palliative treatment unwisely prolonged.[1]

Operative Treatment.—See p. 730.

Seminal Vesiculitis and Deferentitis.—The seminal vesicle very rarely requires treatment during acute urethral gonorrhea. Acute inflammation in it is rare and is habitually but a minor accompaniment

[1] Keyes, *N. Y. Polyclinic Med. Jour.*, 1908, Nos. 9 and 10.

to a more important acute prostatitis. The treatment is the palliative treatment of acute prostatitis.

When active suppuration occurs in or about the vesicle, this is usually not discovered until adhesion with the bowel has taken place. In this event the abscess should be incised from the rectum. But if suppuration tends to spread off into the ischiorectal fossa or threatens the peritoneum, vesiculotomy should be performed.

Epididymitis.—See p. 566.

Pyelonephritis.—See p. 350.

CHAPTER XXV.

LOCAL TREATMENT OF CHRONIC URETHRITIS

The treatment of chronic urethritis is entirely empirical, as is the treatment of chronic catarrh of any mucous membrane. So much depends upon the physical character of the patient himself, and so much upon the precise way in which local treatment is conducted, that it is impossible for any two men to treat the condition by precisely the same method. It is to be borne in mind that the milder forms of chronic urethritis tend to get well spontaneously under proper general and sexual hygiene. The cases that resist local treatment most effectively are not those that most seriously threaten the patient's health, but rather the minor catarrhs; while the more severe inflammations, such as stricture of the anterior urethra and marked suppuration in the prostate and seminal vesicles, usually yield to intelligent local treatment. But it is impossible to decide beforehand precisely what treatment will suit a given case. The most anemic and neurotic patient may be cured by a few irrigations, while the most robust may show a slight catarrh that resists every local and general measure. It is of the first importance, therefore, that the patient's general and sexual hygiene be closely investigated, and every effort made from the outset to put him in the best possible circumstances for overcoming his local inflammation (p. 223).

In the second place, it is important that whatever local treatment is undertaken should be given for the definite purpose of curing a known lesion. Yet this local treatment should be carried out in a purely tentative way, for it is impossible to decide beforehand which of the various lesions along the urethra is the important one, and it is equally impossible to be sure whether any form of local treatment will do good rather than harm until it has been tried. It is, therefore, necessary to conduct treatment with a close eye to results, and, unless some definite change for the better is promptly perceived, the treatment must be changed. In making these changes it is wise, every little while, to take a breathing space—to stop all local treatment and give the urethra a few weeks' rest, controlling the discharge, if need be, by an anterior astringent injection.

Bearing these general considerations in mind, we may proceed to detail the methods of treatment employed, beginning with those most

commonly used and ending with the ones that are only required for exceptional cases, and not forgetting hygiene (p. 223).

INJECTIONS, IRRIGATIONS AND INSTILLATIONS

Unless there is some indication to the contrary, the first local treatment to be employed upon any patient with chronic urethritis is urethral injection or irrigation. It is, perhaps, a matter of taste whether to begin, as a routine measure, by bidding the patient to use injections for the anterior urethra or to return to his physician for irrigations of the posterior urethra. No fixed rule can be given. If the discharge is profuse, it is usually, but not necessarily, wise to begin with injections. If it is slight, irrigations may usually be depended upon alone. The patient's mental attitude, the frequency with which he is able to return for treatment, and the results of experimental treatment in each direction, must be the guide in a given case.

Injection.—The astringent injections are the most generally useful. My preference is for the zinc acetate mixture (p. 213) employed twice a day and retained in the urethra only long enough to fill the canal. No effort should be made to prevent its reaching the deeper portions of the urethra, nor should it be forced into the posterior canal.

If the discharge is profuse and contains gonococci, the organic silver salts, notably protargol, may prove more effective than the astringents; but the more chronic the case, the less likely are the silver salts to do good. Whatever injection is employed may do good at first and irritate later. Its use should, therefore, be intermitted every few weeks. The chief value of this injection is that it keeps the patient clean, by controlling the discharge until time and treatment shall cure the urethritis.

Irrigation.—Having completed the diagnosis in the manner described on p. 194, it is my custom to begin treatment by irrigating the bladder with permanganate of potassium (1:4,000 every day or every other day). Even if the prostate is mildly involved, it is often better to neglect this for the time, until the surface inflammation is a trifle calmed by the irrigations.

If three or four irrigations do no good, a change may be made by increasing the strength of the solution, or by adding to each 500 c.c. ten drops of a 10 per cent silver nitrate solution.

If the prostate and vesicles are markedly involved, massage upon them is begun and continued according to the rules given below.

At this time, also, infiltrations or strictures of large caliber in the anterior urethra are to be sought for (p. 196) and dilated.

Instillations.—If the posterior urethritis is severe, instillations are

to be employed at first, instead of irrigations, while if it is exceptionally mild, but the patient has many subjective, painful, or neurotic symptoms, instillations of nitrate of silver are usually preferable. As the urethritis approaches a cure one should always employ instillations.

DILATATION AND MASSAGE

One of the most difficult problems in the treatment of chronic urethritis is the intelligent use of dilatation and massage. Theoretically, every sclerotic anterior urethra should be dilated until the sclerosis disappears and the surface of the mucous membrane appears healed when observed through the urethroscope. Theoretically, every inflamed prostate and seminal vesicle should be massaged until it no longer yields pus. Practically, the most successful practitioners honor these rules more in the breach than in the observance. Many an anterior urethra becomes and remains apparently well, though it bears untreated scars. Many a prostate continues to excrete pus, in spite of all that can be done by the most vigorous and long-continued massage. Indeed, if one follows these cases as I have done,[1] treating them up to the point of clinical cure, then observing them, and massaging the prostate as part of the observation every few months for a year or more thereafter, one is surprised to note that a prostate, the treatment of which was stopped with some misgivings, will often show less pus in its secretion several months later than it did while treatment was being pushed. If relapse is noted after the interval, especially if that relapse be only in the shape of an increased amount of pus in the secretion, without any subjective symptoms or urinary signs, a few rubs usually set things right again.

On the other hand, if dilatation is persisted in until the urethroscope shows a perfectly satisfactory condition of the mucous membrane, or if massage of the prostate and vesicles is persisted in, long after the disappearance of symptoms and urinary signs, in the hope of expressing a last pus corpuscle from these organs, the case is likely to be sadly overtreated. This is especially true in the matter of massage. It is almost impossible to remove the last trace of pus from the prostate, the seat of severe or prolonged chronic inflammation. After a thorough course of rubbing with this end in view, the prostatitis is quite as likely to relapse as though the patient had been more moderately treated, with a view to controlling and not eradicating the prostatic suppuration. Relapse after such a course of treatment is the making of a sexual neurasthenic.

The fear, so commonly expressed both by the profession and by the

[1] *Jour. Am. Med. Assn.*, 1904, xliii, 187.

laity, that chronic prostatitis leads to prostatism, is without clinical foundation. In the report referred to I have shown that, among men of a given age, prostatic retention is less common if they have suffered from severe and prolonged prostatitis in their youth than it is among their more fortunate brethren who either deny gonorrhea absolutely, or, at most, have not had severe prostatic inflammatory complications from this disease. Were prostatitis so much to be dreaded as a cause of prostatism as some of our brethren maintain, given the fact that prostatitis is so common a complication of gonorrhea as these same brethren gladly admit, one might expect to see in the generation which has now passed its fiftieth year, and which went through its gonococcic period at a time when no finger invaded the prostatic penetralia, an overwhelming proportion of prostatics—many times more than the clinic actually shows.

Theory of Dilatation and Massage.—The important pathologic changes of chronic urethritis occur chiefly below the surface, in the glands of the anterior and the posterior urethra, and in sclerosis of the mucous membrane about these inflamed glands. The reason for employing dilatation of the anterior urethra and massage of the posterior urethra in the treatment of chronic urethritis is, therefore, twofold. First, in order to express the accumulated secretions from the glands and thereby to permit them mechanically to return to a more normal condition; and secondly, by making pressure upon the inflammatory tissue about these glands, and especially about their orifices, to encourage resorption of this exudate and to discourage its change into a permanent scar.[1]

One might suppose, *a priori,* that every chronic urethritis, therefore, required either dilatation or massage, and more probably both, but such is far from being the case. Some inflamed urethras heal not only as well, but even better, without these measures. Massage of the prostate and vesicles may prove irritating rather than beneficial, and the danger from irritation by the use of sounds and dilators in the urethra is well known. Moreover, the moderately inflamed anterior or posterior urethra gets well without mechanical pressure in many instances. Hence, it is well to reserve massage, and even more carefully to reserve dilatation, for those cases that really need it—that are not curable without it. One can scarcely be too enthusiastic about the advantages of these methods of treatment if one always bears in mind their dangers.

Technic of Dilatation.—If examination with the bulbous bougie reveals an induration in the anterior urethra, which is not promptly ameliorated or cured by irrigations, it should be dilated. If the pa-

[1] The use of electricity (Newman), hot solutions or hot sounds (Porosz, *Am. Jour. of Urol.,* Jan., 1911), to excite hyperemia and replace dilatation, has not met with any general success.

tient's meatus is sufficiently large, the dilatation should be begun with sounds, and these should be carried to the limit of the meatus. The urethra should be dilated not more than three numbers at a given occasion, and the usual precautions as to hexamethylenamin and local antisepsis should be employed.

When the first sound is passed, the urethra should be palpated upon it to discover any perceptible infiltrations or minute glandular indurations, and if these are found they should be gently massaged each time the sound is introduced thereafter until they disappear, or until it becomes evident that they are permanent scars.

Sounding should be repeated twice a week, and when the limit of the meatus is reached, dilatation with the Kollmann dilator should be begun. In using the dilator it is often possible to advance much more rapidly than with the sound. The instrument is screwed up gently, one waits a moment, and then gently turns the wheel a trifle more. By thus turning intermittently, one gains two or three numbers with little pain to the patient and without exciting much bleeding.

I see no advantage in leaving sounds or dilators in the urethra for more than a few moments after the desired dilatation has been achieved.

It is a general rule that bleeding is a sign of too severe dilatation. Yet, if the surface of the urethra is much inflamed, the very introduction of the instrument may cause bleeding.

Contra-indications to Dilatation.—While gonococci persist in the urethra, dilatation is dangerous. It may do good; it is more likely to do harm. While the urine contains free pus, even though that pus show no gonococci, dilatation is still somewhat dangerous, and should be undertaken only after every effort to clear the urine of free pus has failed; but when only a very light, purulent cloud remains, and the urine shows many shreds, dilatation is likely to be most serviceable and almost free from danger. Yet it is always possible that the dilatation may excite acute prostatitis or epididymitis. These may be avoided, to be sure, by restricting the dilatation to the anterior urethra. Yet the dilatation, to be efficient, must include the posterior urethra, since the bulb and the membranous portion are likely to be the regions most in need of stretching.

The sensitiveness to dilatation may be overcome by the use of local anesthesia.

Technic of Massage.—One often speaks of massaging the prostate; but it is prudent, in view of the fact that the vesicles may be inflamed even when they feel normal, always to massage the vesicles first and then the prostate, no matter which organ feels the most diseased, though paying most attention to obviously diseased regions.

The question whether these organs should be massaged severely or gently cannot be decided academically. A physician who rubs so hard

as to make many of his patients faint loses many a case before it can be cured; and, on the other hand, the physician who massages too gently fails to cure certain cases that require severe rubbing. The intelligent practitioner will rub gently at first and increase the severity of the manipulation up to the point of the patient's endurance, and with an eye to the results obtained. Severe massage may do physical harm by exciting acute prostatitis, vesiculitis, and epididymitis. Mild massage very rarely does this. No two physicians massage with precisely the same method or with precisely the same severity, as patients are quick to note.

A simple method is to begin upon one vesicle, and, reaching up as far toward its fundus as possible, to press upon it and then withdraw the finger in a zigzag way until one reaches the prostate. This maneuver is repeated half a dozen times and then the same treatment given to the opposite vesicle. If the vesicles are impalpable, this is enough. If distended or indurated, the maneuver should be repeated often enough to make a distinct reduction in their size, if the patient can bear so much manipulation.

The finger is then brought down to the prostate. Hard, angular indurations in and about this organ had best be avoided, and pressure made chiefly upon the more yielding portions of the gland. Beginning with one lobe, pressure is made upon it either with a to-and-fro lateral sweep of the finger or with a circular motion. This manipulation, if gentle, may be continued for one minute; if severe, half a dozen strokes may suffice. The same treatment is given the opposite lobe of the gland, and the manipulation concluded by a half dozen strokes over the prostatic sinus for the purpose of emptying the main ducts into the urethra. The general tendency of all such massage should be to express the secretions in the direction of the apex of the prostate.

Meanwhile, watch is kept for the expulsion of secretion from the meatus. This is caught upon a slide for examination.

Massage should usually be repeated not oftener than two or three times a week. If severe, longer intervals are better. In exceptional cases, when the return from massage is very great, gentle rubbing may be employed once a day. Massage should be continued until the subjective symptoms are relieved, and the return from the rubbing very slight and not densely purulent. If the return to normal is rapid, one may continue to rub until all pus disappears. The success of treatment must almost always be verified by three or four observations at intervals of one to three months. If pus has reaccumulated during these intervals, a few rubs will get rid of it.

Contra-indication to Massage.—Massage is dangerous only in the presence of acute inflammation of the urethra, the prostate, the vesicle, or the epididymis; but massage is harmful in case it increases

the patient's subjective symptoms instead of relieving them. It is also harmful in case it so hypnotizes the patient that he thinks he must come for the rest of his natural days to be rubbed for the relief of imaginary discomforts. Such patients should be discouraged from massage by all possible means. Their proper cure is sexual relief by matrimony.

THE RECTAL DOUCHE

The rectal douche is an accessory or substitute to massage of the prostate and vesicles. The usual case, that can perfectly well submit to massage, need not bother with douches. But if the patient cannot reach his physician often enough for massage, if the inflammation is too acute for massage, or if massage proves irritating, the rectal douche should be employed. The object of the rectal douche is to apply heat or cold to the prostate or vesicles. The mechanism and technic have already been described (p. 209). The injection should be repeated every day, with an interval of a few days, every two or three weeks, to make sure that the bowel is not being irritated. Some patients note an immediate sense of relief from the use of the rectal douche, but the majority do not, and it is often difficult to persuade a patient to go on, week after week, using a treatment which is a great nuisance and which does not appear to him beneficial. Yet the rectal douche is one of the few forms of treatment that may be continued for months at a time, with only such intervals as are necessary to insure the comfort of the bowel.

OPERATIVE TREATMENT

In the absence of complications specifically requiring operations, such as intractable stricture, or abscess, it is, generally speaking, unwise to operate upon cases of chronic urethritis. Intractable cases of prostatic neuralgia have been cured by scraping the posterior urethra, but such a treatment would seem more likely to do harm than good in most cases. Young[1] advises prostatectomy for the treatment of chronic prostatitis; but his best results are obtained in cases of retention, and it is obvious that retention from prostatic bar or contracture in a young man requires the same operative treatment for its cure as does prostatic retention in the aged. Dilatation does these cases no good.

Operations for the Relief of Vesiculitis.—The operative relief of infections of the seminal vesicles has been attempted in two ways: by drainage through the vas deferens, and by direct operative attack upon the vesicle itself.

[1] Johns Hopkins Hospital Report, vol. xiii.

Belfield's Operation.—Belfield picks up the vas in the scrotum, incises it after local infiltration of the skin with cocain, injects the proximal end of the duct with 10 per cent argyrol or 4 per cent collargol, and fixes the duct in the wound so that any reflux of the fluid injected will issue from the wound itself and not flow into the subcutaneous tissue, there to cause an irritative phlegmon. He hopes thus to obtain both antisepsis and drainage of the vesicle. Edema around the little wound interferes with subsequent injections. Excellent results have been reported from this operation, and it is believed that if the vas is not completely divided or if it is brought together again by a single catgut suture so that the two ends are opposed to each other, occlusion of the vas does not occur. (Contrary to what one would expect, experiments seem to bear out this statement.)

Thomas has suggested that the injection be made through a needle puncture of the exposed vas. This readily finds the lumen and supplies antisepsis without drainage. Whatever form of operation is employed, care must be taken not to infiltrate the tissues about the vas.

The operation is simple enough. In my hands it has been quite without effect excepting in a few cases of recurrent epididymitis. I am inclined to suspect that the benefit in these cases has been due to occlusion of the vas at the point of operation.

Vesiculotomy and Vesiculectomy.—The direct attack upon the vesicle is much more successful, both for the relief of rheumatism and of pain. Most authors employ vesiculotomy, though Cabot, believing that no simple incision can really drain such a complicated tube as the vesicle, has employed vesiculectomy. The operation unquestionably relieves the rheumatic pain of a large class of patients, but it fails in a totally indeterminate number of cases. When vesiculotomy fails, vesiculectomy combined with prostatectomy may succeed, though even this does not guarantee a cure. The operation has been applied to a very loosely classified type of painful cases; its value in the treatment of these is open to doubt. I have employed it several times with no success. In the acute stages of gonorrheal rheumatism it is likely to prove brilliantly successful, but many of these cases are readily relieved by other means. Therefore the operation is usually reserved for intractable cases, the majority of whom it cures. It does not, however, protect the patient against a relapse, if he becomes re-infected with gonorrhea.

Impotence follows vesiculotomy in a very small percentage of cases. It is a common result of vesiculectomy. I have operated upon but very few cases and with no resulting impotence.

URETHROSCOPIC TREATMENT (See p. 203)

The anterior urethra should be examined with the urethroscope, either at the time that dilatation seems indicated or at the time that it fails to do good. If urethroscopic observations are made throughout the course of treatment, the disappearance of infiltrations and the return of the mucous membrane to normal, or the final scarring of the urethra may be noted.

Urethroscopic treatment may be considered under two heads, viz.:

1. Topical applications to various inflammatory lesions of the anterior and posterior urethra, and

2. Treatment of the urethral neuroses usually dependent upon inflammation of the verumontanum and utricle.

Topical Applications.—If anterior urethritis resists treatment by the ordinary injection and dilatation, the urethroscope usually reveals localized areas of infiltration, in the midst of which are seen inflamed glands which may or may not exude pus. Applications to these spots may be made through the urethroscope by means of a cotton tampon on a wooden applicator. Nitrate of silver in 5 per cent to 20 per cent strength is the drug most commonly used. Sulphate of copper may be used in the same strength, or equal parts of iodin and carbolic acid may be employed. The applications are made precisely to the inflamed spot, after it has been touched with a dry piece of cotton, in order to rid it of secretions. No excess of the solution should be permitted to run over healthy parts of the mucous membrane. The treatment may be repeated not oftener than twice nor less often than once a week. I cannot say that it has succeeded brilliantly in my hands. Swinburne praises the fulguration treatment of such lesions.

For suppuration in a paraurethral canal the best treatment is injection of 10 per cent nitrate of silver. If this fails to cure after two or three injections, the canal should be split from end to end by means of a urethroscopic knife (Janet's trajectotome is the most convenient instrument), or destroyed by fulguration.

Granulations and papillomata are also readily destroyed by fulguration.

TREATMENT OF URETHRAL NEUROSES

The neuroses due to chronic prostatitis and seminal vesiculitis may or may not be postgonorrheal, as has already been suggested. Yet they are often attributed to gonorrhea by the patient, and are, therefore, considered under this aspect.

They may be divided into three groups:

Sexual neuroses.
Painful neuroses.
Sexual neurasthenia.

To these may be added, for the sake of convenience:

Prostatorrhea.
Spermatorrhea.

In order properly to treat these various conditions, an accurate diagnosis is necessary as to the presence of complications.

If gonococci are present, one must first get rid of these by appropriate measures. If the prostate and vesicles are markedly inflamed, these must be massaged until the amount of pus expressed is reduced to a minimum. If there is stricture, this must be dilated; if there is residual urine without any other pathological cause, this may be set down to the sclerosis of the prostatic glands about the bladder neck, and is best treated by incision with the galvanocautery (p. 746). If the urethra is hyperesthetic, this oversensitiveness must be dulled by the gentle passage of sounds as large as the patient can bear.

The proper treatment for pain is the treatment which strikes the painful spot. Thus, if pressure upon the prostate or upon the vesicle excites a discomfort which the patient recognizes as that from which he suffers, massage of these organs will relieve this discomfort; if the passage of a sound strikes the painful spot, sounds are likely to cure; if touching the verumontanum with a swab introduced through the posterior urethroscope excites the pain, this is likely to prove the proper point of attack. In these cases above all others, care should be taken not to persist too long in any one course of treatment with blind insistence that this treatment must cure. Unless the progress of the case is entirely satisfactory, no given course of treatment should be persisted in for more than three weeks.

Finally, so many of these difficulties depend entirely upon sexual irregularities and derangements that the patient's sexual habits, both previous and present, should be intimately investigated, and every effort made to lead him to as clean, as wholesome, and as normal a sexual condition as it is possible for him to attain. Although matrimony cannot be prescribed like a pill, and although these patients are often sorry subjects to place on any woman's hands, truly happy married life is often the only real remedy for the patient's condition, and, unfortunately, almost as often it is a remedy beyond the patient's reach.

But the great majority of urethral neuroses are due to inflammation in and about the verumontanum and utricle.

Treatment of the Verumontanum and Utricle.—The urethroscopic treatment of these lesions is described on page 204. We may summarize the status of treatment as follows:

The sexual element is all-important. Moral control of the patient is more essential than physical treatment. Mild measures may succeed where severe ones fail. Two drops of 10 per cent silver nitrate solution can be placed quite as accurately upon the verumontanum by the instillator as by the urethroscope. If instillations fail, the urethroscope may succeed, both by revealing lesions, and by permitting more severe cauterization.

CHAPTER XXVI

SPASMODIC AND CONGENITAL STRICTURE

A loss of dilatability of any portion of the urethra constitutes stricture. This loss must be unnatural, for the urethra has certain points of normal contraction—namely, the meatus, the middle of the pendulous, and the beginning of the membranous urethra, and these are not strictures. They become so, however, if unduly small.

True stricture is of two kinds: (1) Muscular or spasmodic; (2) permanent or organic—the latter congenital or acquired. Any inflammation lessens the caliber of the canal in proportion to the turgescence of the mucous membrane; but no amount of inflammation constricts the canal enough to occasion serious symptoms, unless occurring in connection with abscess or stricture.

Obstruction of the urethra by stone, slough, or foreign body does not constitute stricture.

MUSCULAR OR SPASMODIC STRICTURE

Spasmodic stricture is an involuntary contraction of the compressor urethrae muscle of sufficient force to impede or to prevent, temporarily or permanently, the passage of urine from the bladder. I have encountered no case of spasm of the pendulous urethra, though De Bovis [1] records two cases.

Spasmodic stricture is a symptom, not a disease. It always depends upon some separate and distinct condition. It varies with the variations of this etiological factor and disappears with its cure.

A common predisposing cause is a sensitive, high-strung nervous organization, particularly in one who is sexually excessive. Such a one is unable to urinate in the presence of his fellows, and the more anxious he is to pass his water, and the more water there is to pass, the more difficult does he find it to satisfy his desire. Certain mental suggestions contribute to increase or to diminish the spasm. The sound of running water often breaks the spell, while derision or absolute silence has the opposite effect. I have known a commercial traveler who, during twenty years of life spent mostly on the road, could not urinate in

[1] *Gaz. des hôp.*, 1897, LXX, 583.

a railroad car except by means of a catheter. Yet such a man may well go through life with no great inconvenience from his urethral idiosyncrasy, his *urethrismus,* as Otis termed it. But let him acquire an organic stricture or a vesical calculus, let him be operated upon for hemorrhoids, or suffer any local or constitutional strain or shock, and his urination immediately becomes difficult or impossible to accomplish for a greater or less space of time. I have known an operation for hemorrhoids to occasion complete retention lasting ten days, long after the patient was up and about. Such a spasm, if unrelieved by catheterization, may even cause rupture of the bladder. Thus there is this much in the theory of Otis that an abnormally small meatus may cause urethrismus, that if the meatus is small enough to irritate the urethra by impeding urination, it may excite a spasmodic stricture, though I have never known it to do so.

Symptoms and Diagnosis.—The cardinal symptom of spasmodic stricture is inability to urinate. Hence, it is sometimes confounded with organic stricture. Indeed, not a few patients with stricture deemed impassable, when put upon the operating table, have been found to admit a full-sized sound, being cases of spasm with little or no organic stricture. The following differentiating points are therefore memorable:

1. Spasmodic stricture occurs only in the membranous urethra.

2. Unless there is some organic lesion of the urinary tract the urine is bright and sparkling and free from shreds, which it very rarely is if there is organic stricture sufficiently marked to seriously arrest urination.

3. Although it may be impossible to introduce a filiform bougie or a small sound, a full-sized sound, if allowed to rest for a few moments against the face of the stricture, will usually tire the muscle, and finally slip into the bladder. If it slips in by its own weight its course will often be jerky and irregular, as the muscle gives way by succeeding spasms of lessening intensity.

4. When the instrument is once introduced the obstacle is wiped out, and the withdrawal of the instrument is not opposed by any such grasping as is felt when there is tight organic stricture.[1]

5. Even though a spasmodic stricture be absolutely impassable, general anesthesia will entirely relax it.

6. Organic and spasmodic stricture often co-exist.[2] Indeed, organic stricture is the most common cause of spasm, and spasm may be the notable symptom of an organic stricture of large caliber.

[1] But if the instrument passed is a small one (less than 20 F.) it does not overstretch the muscle and may therefore be grasped on withdrawal.

[2] Indeed, continued spasm may doubtless cause ulceration, just as spasm of the bowel causes fissure in ano. (Cf. Keyes, *Am. Jour. of Urology,* 1905, i. 218.)

Treatment.—The retention may be relieved by a hot sitz bath or by catheterization.

The tendency to spasm is overcome by removing the cause and improving the general hygiene, special attention being paid to sexual irregularities, concentrated urine, and organic stricture.

To prevent recurrence of the spasm I know nothing better than the passage of a full-sized steel sound to overstretch the muscle, and silver nitrate instillations to blunt the sensibility of the deep urethra.

CONGENITAL STRICTURE

Congenital strictures, or even total occlusions of the urethra, usually occur at three places, though they may occur anywhere in the canal:

1. At the meatus.
2. At the outer limit of the fossa navicularis (internal meatus) and
3. At the membranous urethra.

The stricture takes the form of a valve or a stenosis. Englisch recognizes two types, those that are present during fetal life, but disappear later; and those that persist. Such strictures at any point deeper than the internal meatus are rare and usually cause death by retention, *in utero* or in infancy. Bazy [1] has however operated upon several cases and I have cut two.

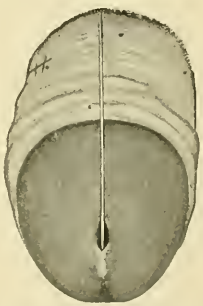


Fig. 46. — Congenital Stricture of the Meatus. A probe is inserted into the pocket behind the stricture.

On the other hand, congenital stricture at the meatus, or at the outer end of the fossa navicularis (aptly termed the second meatus), is very common. Indeed, the size of the meatus is no more fixed than the size of the mouth or the nose, though, in general, a small penis is more likely to have a contracted meatus than is a large one.

How much contraction constitutes stricture of the meatus? Strictly speaking, a meatus is stric tured if a probe, introduced into the fossa navicularis and rotated so as to sweep the point outward along the floor of the urethra, encounters a thin membrane which it must surmount in coming out through the meatus. This obstruction always occurs on the floor of the canal, and is never anything more than a fold of mucous membrane that may be pushed out by the probe (Fig. 46). The second meatus is strictured if it is not so large as the normal true meatus.

Strictly speaking, the above rule holds good. Practically, however, stricture of the meatus—to which so many reflex ills were once attributed—rarely produces any symptoms. If actually so small as to

[1] Cf. Neumann, *Zeitschr. f. Urol.*, 1910, iv, No. 11.

interfere with urination it may, perhaps, like a tight prepuce, cause hernia or even epilepsy in a child, and spasmodic stricture in later life, and the urethra may become considerably dilated behind it. But such cases are exceptional. Most men can go through life in blissful ignorance of the size of their meati unless they acquire a urethritis, in which event the stricture should be cut lest the little pocket behind it perpetuate the inflammation.

Treatment.—The only way to cure a stricture of the meatus is to cut it. As above remarked, this is, as a rule, quite unnecessary, except for the surgeon's purposes.

The operation of *meatotomy* has occasioned the invention of various more or less ingenious *meatotomes,* of which the best is a blunt-pointed straight bistoury. This is the only instrument required, and the operation may be very neatly performed as follows: After cleansing the parts with soap, bichlorid, and alcohol, a cocain tablet is inserted within the meatus and pressed into the little pocket below it. This is dissolved by dropping upon it two drops of 1: 1,000 adrenalin solution. In a few moments the tip of the meatus is seen to blanch. The bistoury is then inserted and the membrane deliberately divided upon a finger placed beneath the frenum, which appreciates the fibrous ring about the meatus and at the second meatus, and by feeling the blade of the bistoury beneath the skin recognizes when they have been effectually divided. The passage of a bulbous bougie proves that the obstructions have been sufficiently cut. If this technic is observed there will be no pain and little bleeding. The meatus is flushed clean and packed with cotton. The cotton is removed at the first act of urination, and the wound is kept open by inserting the curve of a clean hairpin into the urethra once a day. The hemorrhage may be profuse if no hemostatic applications are made, but there are no other complications, and lateral pressure will always check the flow of blood.

Some surgeons prefer to suture the little wound in order to hasten healing and to prevent adhesion.

CHAPTER XXVII

ORGANIC STRICTURE OF THE URETHRA—ETIOLOGY, PATHOLOGY, SYMPTOMS, RESULTS, DIAGNOSIS

Although two conditions commonly known as stricture have been described in the preceding chapter, the one, spasmodic stricture, is a mere symptom, and the other, congenital stricture, a condition which, except in extreme cases, is absolutely innocuous. Organic stricture, the stricture that is never innocuous and always active in its work of undermining its possessor's health, except when kept at bay by the surgeon's efforts, has yet to be considered.

True organic stricture of the urethra is a cicatrix of the urethral wall left there by some injury or inflammation, and manifesting a constant tendency to contract, and thus to diminish the lumen of the urethra. This tendency to contraction, which is always manifested in a greater or less degree, is doubtless caused by the irritation incident to micturition, the impact of the stream against the barrier; for the deepest stricture, the one that most obstructs the flow of urine, is almost always the tightest, and if the stricture is kept dilated so as to afford little or no obstruction, the tendency to recontraction is slight.

Stricture occurs in the female as well as in the male urethra. But this lesion in the female is much less common than in the male, and manifests no distinguishing peculiarities, either in pathology, symptoms, diagnosis or treatment.

Oberlaender very properly refused to recognize any pathological distinction between chronic anterior urethritis and stricture. The pathological difference is only one of degree; but the clinical distinction is clear. Infiltrations larger than 26 F. are readily cured by dilatation and show but a very slight tendency either to relapse or to contract. But infiltrations tighter than 26 F. show a marked tendency to contract progressively and require the treatment described in the ensuing pages to cure or even to control them.

VARIETIES

Strictures may be classified from several points of view: thus, for prognostic purposes, strictures are considered as anterior (at or in front

of the penoscrotal angle) and posterior (behind this point); therapeutically considered, strictures are of large caliber (admitting a 20 F. bulbous bougie) or of small caliber; while from a pathological and etiological point of view strictures are classified as gonorrheal and traumatic. The old descriptive division into linear, annular, and tortuous or irregular stricture is clinically convenient to describe the nature of the obstruction to the exploring instrument, and the terms soft, fibrous, and inodular (or indurated) are descriptive of important features.

ETIOLOGY

All true strictures are either inflammatory or traumatic, and almost all inflammatory strictures are gonorrheal.

By far the greater number of strictures are gonorrheal. Thus out of 220 cases studied by Thompson, 164 (75 per cent) owed their origin to gonorrhea; while Martin found among 219 cases 187 gonorrheal strictures (85 per cent). My office case books record 583 gonorrheal to 43 traumatic strictures.

The *causes of gonorrheal stricture* are, however, many. The inflammation itself usually causes the stricture; but it is difficult to estimate what proportion of strictures is due to breaking a chordee, to a false motion in coitus causing a tear in the inflamed mucous membrane, to the ill-advised use of caustic injections for the purpose of aborting the attack, or to the injudicious use of instruments in the urethra before the attack has subsided. Such strictures are properly traumatic, since trauma of the same kind, but greater in degree, may cause stricture when the mucous membrane is not inflamed and the gonorrhea thus only plays the rôle of a predisposing cause.

There is a small class of *intermediate cases* in which the stricture is neither absolutely inflammatory nor traumatic. To this class belong strictures caused by urethral chancres [1] and ulcerations, or loss of substance from periurethritis, etc.

The *causes of traumatic stricture* vary widely. The *penile* portion of the urethra may be divided by knife or bullet, or torn by bending the erect penis, by a false motion in coitus, or by breaking a chordee. The *bulb* is the portion usually affected by trauma from within, by ulceration from stone, foreign body, or retained catheter, or by the sharp point of a blundering instrument. The *prostatic* urethra is said to become strictured when torn by disruption of the pelvis.

But of all traumatic strictures, recognizable as such, stricture of the *membranous urethra* is the most frequent. The stricture is caused by

[1] Ten cases of diffuse urethral syphiloma have been reported. *Guyon's Annales*, 1898, xvi, 892.

a crushing force applied to the perineum, which brings the urethra sharply into contact with the subpubic ligament, crushing it beneath the sharp edge of this structure or tearing away from it in front.

The injuries which have caused traumatic stricture in the perineum, with or without a penetrating wound, are innumerable. They may be summarized in the term "straddle injuries." They may be overlooked by the patient if they do not give rise to immediate hemorrhage or retention. Yet in after years symptoms of stricture come on, and the canal is found tightly contracted at its membranous portion.

Pathogenesis.—The most notable modern theories upon the formation of stricture are the theory of Finger and the Guyon school, and the theory of Guiard.

The Finger-Guyon theory [1] makes stricture the result of chronic urethritis. According to these authors, chronic urethritis is essentially a sclerotic process, characterized by deposits of cicatricial tissue in the submucosa and even in the corpus spongiosum. This fact is illustrated by numerous pathological findings that would prove its truth were it not contradicted by the notorious clinical facts.

For although, as we have seen, acute urethritis is an exudative process that does tend to pass into a chronic sclerotic stage, the essential cause of the exudation is the acuteness of the attack and the extent of exudation, and subsequent cicatrization is proportional rather to the acuteness of the attack than to its duration. Hence, although stricture is always accompanied by chronic anterior urethritis, chronic anterior urethritis may exist for years without inducing stricture.

We therefore accept Guiard's theory,[2] that stricture depends upon the virulence of the urethral inflammation. The more severe the initial attack, the more intense the chordee, the more frequent and violent the relapses, and the longer the gonococcus can be found in the discharge, the greater is the probability of stricture. He believes that in a mild chronic stage the urethral inflammation is neither deepseated nor productive of any permanent lesion; while the acute inflammation, with its involvement of the lacunae and glands, its circumscribed or diffused areas of periurethritis, is the inflammation calculated to leave behind permanent scars in and beneath the mucous membrane.

In the etiology of *traumatic stricture* urinary infiltration must play some part. It is true, severe contusion and laceration of the urethral wall are ample causes for stricture; but it is incredible that the muscular disturbance of urination and the distention of the wound with a fluid containing urinary salts and urethral bacteria should cause no increase

[1] Finger, *Internat. klin. Rundschau,* February 12, 1893. Wassermann and Hallé, *Guyon's Annales,* 1891, ix, 143 *et passim.* Wassermann and Hallé, *Ibid.,* 1894, xii, 244, 321.

[2] "Les uréthrites chroniques chez l'homme." Paris, 1898, p. 90 *et seq.*

in the inflammatory reaction. The admirable results obtained by simple perineal section and diversion of the stream of urine from the wound confirm this belief.

In this connection *the time of occurrence of stricture after gonorrhea and injury* is of interest. Of the 164 cases of stricture following gonorrhea, tabulated by Thompson, in 10 symptoms appeared immediately after or during the attack; 71 within one year; 41 between three and four years; 22 between seven and eight years; 20 between eight and twenty-five years. Hill[1] makes the length of the period between the cause and the first symptoms of stricture noticed: after gonorrhea, shortest period two years, longest thirteen years; after urethral chancre, shortest period ten months, longest three years; after injury, shortest period four months, longest eighteen months. I found among 212 cases of gonorrheal stricture 121 cases within the first year, 65 distributed between the second and tenth years, and 26 after the tenth year. On the other hand, I have seen an impassable stricture in the perineum six weeks after a severe injury, and Guyon[2] has met a stricture which only admitted a 16 F. sound two weeks after injury, and another which would not admit a 12 F. after six weeks.

The deductions from the above statistics, confirmed by daily observation, are that the symptoms of stricture appear earlier after traumatism than after gonorrhea (the date of their appearance being measurably proportionate to the extent of the injury) and that the greatest divergence is noticeable after gonorrhea. It is totally exceptional, however, for symptoms of organic stricture to come on immediately after or during the attack of gonorrhea—as Thompson states occurred in ten of his cases—unless stricture existed previous to the attack, unnoticed by the patient.

PATHOLOGY

Number of Strictures.—While Thompson,[3] in examining 270 pathological specimens, found only 44 cases of multiple stricture, Guyon[4] lays down the clinical rule that gonorrheal strictures are multiple, while traumatic strictures are single. These statements, properly interpreted, conform perfectly with each other and with the facts. Concerning traumatic strictures, there is no doubt; they are almost always single. But gonorrheal strictures, while frequently single from the pathologist's point of view, often present a number of ridges to the examining sound.

[1] "An Analysis of One Hundred and Forty Cases of Stricture of the Urethra." London, 1871.

[2] "Leçons cliniques," 1894, vol. i, p. 239.

[3] "Stricture of the Urethra." Second edition, 1858, p. 76.

[4] *Op. cit.*, I, 139.

Clinically, therefore, gonorrheal strictures are often multiple, pathologically they are usually single.

Seat of Stricture.—Thompson divides the urethra into three regions:

1. The bulbomembranous, including 1 inch in front of and ¾ inch behind the junction of the spongy with the membranous urethra.

2. From the anterior limit of region 1 to within 2½ inches of the meatus, embracing from 2½ to 3 inches of the spongy urethra.

3. The first 2½ inches of the canal from the meatus.

His 270 preparations showed 320 strictures: 67 per cent in region 1; 16 per cent in region 2; 17 per cent in region 3.

Otis placed a majority of all strictures within the first 1¼ inches from the meatus—the next most common position being somewhere in the middle portion of the pendulous urethra. He believed deep urethral stricture to be far less common; but these views depended upon his theory that the urethra is a tube evenly calibrated throughout. Therefore the points of physiological narrowing or of non-contracting infiltration left by urethritis (p. 161) he denominated stricture.

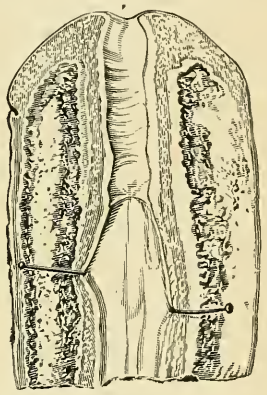


Fig. 47.—Stricture of Anterior Urethra. (Voillemier.)

It is convenient to associate the region in which the stricture occurs with its cause. Thus, strictures at or near the meatus, if not congenital, are usually caused by chancrous or chancroidal ulceration, less frequently by caustic injections and by gonorrhea. Strictures of the pendulous urethra are commonly gonorrheal. Strictures of the bulb and at the bulbomembranous urethra are also commonly gonorrheal. Strictures of the membranous urethra are rarely gonorrheal, almost always traumatic. Stricture in the prostatic urethra may be gonorrheal or traumatic.

Form of Stricture.—In the first place, the stricture is usually chiefly built up from the floor of the canal. This is most notable in the bulb, and commonly results in an eccentric position of the orifice of the stricture, close to the upper wall of the canal. The cause is not far to seek. It is in the loose floor of the canal, especially in the pocket of the bulb, that the gonococci commit their greatest ravages. It is the floor of the canal that is most often torn or crushed. It is the floor of the canal that is damaged by overdistention, when urination is obstructed.

In the second place, it is a matter of clinical experience that in the broad, irregular strictures that are clinically multiple, the constrictions become progressively narrower as they approach the bladder. Beginning, perhaps, at the penoscrotal angle, there is a constriction which admits a 20 F. sound. A short distance farther on this, too, is ob-

structed, and only a 15 F. will pass, and finally the stricture in the bulb admits only a filiform instrument. In other words, the deeper extremity of the stricture, which receives the strongest impact of urine, is more irritated than the rest and contracts more rapidly.

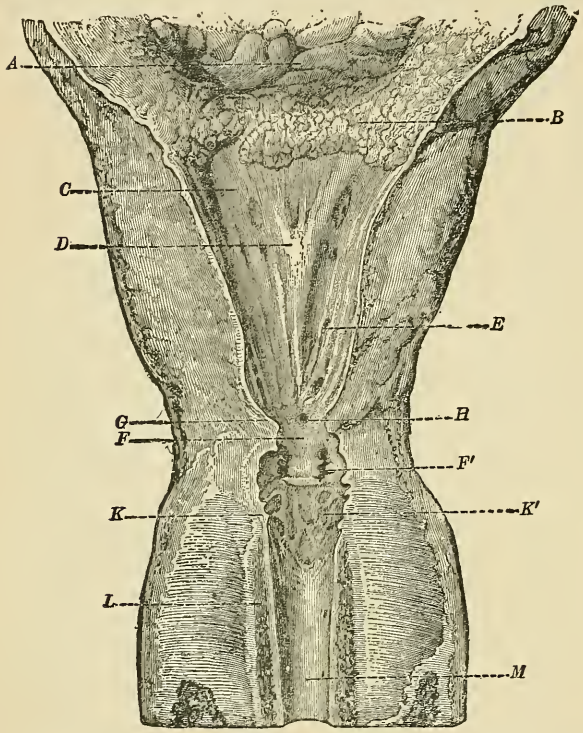


Fig. 48.—Stricture of Membranous Urethra. (Voillemier.) A, bladder; B, bladder neck (ecchymotic); C, dilated prostatic urethra; D, verumontanum; E, one of the prostatic ducts; F, G, K, the stricture; F, dilatations in front of the tightest part of the stricture; H, orifice of small abscess cavity; K, mucous membrane in front of the stricture, thin and ulcerated; L, corpus spongiosum; M, anterior urethra.

Gross Pathological Changes (Figs. 47, 48, 49).—When the strictured urethra is slit longitudinally, the mucous membrane may be found only slightly thickened and congested. Or it may be cicatricial in character or covered with granulations. A band or a mass of cicatrix may replace the mucous membrane throughout its thickness, and may even penetrate the corpus spongiosum. This tissue may be slight in extent, cicatricial in character, tightly contracted; or it may be exuberant, knobbed, and excessive in amount, so as to be readily felt from the outside of the canal. In this callous, fibrous mass there may be irregular areas of inflammation and suppuration. Behind the stricture the canal is distended and more or less extensively ulcerated, and immediately in front of the stricture there may be lesser dilatations and ulcerations.

If the retention has been prolonged and grave the upper urinary organs show the results of retention and infection illustrated in Fig. 49 and described on p. 334.

Microscopic Changes.—These have been described (p. 160).

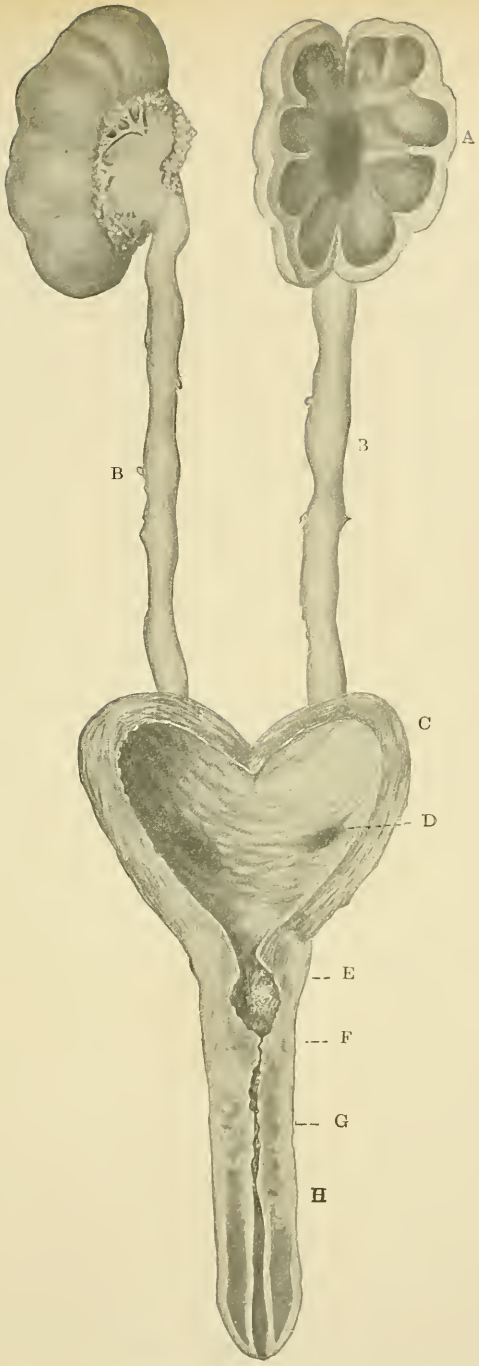


FIG. 49.—RESULTS OF STRICTURE. A, A′, Kidneys dilated, sclerosed, pyonephrotic; B, B′, ureters irregularly dilated; C, bladder contracted and thickened (concentric hypertrophy); D, dilated ureteral orifice; E, prostatic urethra dilated (prostatic abscess); F-H, the stricture; F, its tightest point; G, corpora cavernosa involved in the scar.

SUBJECTIVE SYMPTOMS

Organic stricture may exist for years, producing no symptoms and unsuspected. On the other hand, the usual symptoms of stricture, gleet, the irregular stream of urine, and the final dribble, are of daily occurrence among men who have not, and never had, stricture.

The Onset.—Symptoms occur within one year in over half the cases, though one-quarter of them show no symptoms until after five years have elapsed, and the onset may be deferred for 15 years or even longer. But only one-third of my (private) cases submitted to treatment within a year of the beginning of their symptoms; another third within five years; and one-seventh delayed treatment until their symptoms had existed for 10 or more years.[1]

Gleet.—The initial symptom is usually the presence of shreds (*Tripperfäden*) and more or less free pus in the urine. If the stricture follows immediately after a gonorrhea the urethral discharge is perpetuated; but more often there is a lull while the shreds, and perhaps the general cloudiness of urine, persist, but, in the absence of a notable gleet, do not attract the patient's attention. The shreds and pus are evidence of the local inflammation on the stricture, which is adding fuel to the flame, and encouraging extension and contraction of the fibrous tissue beneath.

As the stricture contracts the urethritis grows worse and, sooner or later, produces a moderate chronic discharge, perhaps only visible in the morning when the urethra has not been scoured by the urinary stream for eight hours, perhaps persisting throughout the day. This is *gleet.* It is usually the first symptom noted by the patient. The gleet of stricture gets better or worse according to the general condition of the patient, the degree of acidity of the urine, and the amount of sexual indulgence or of venereal excitement. Exacerbations of gleet from slight causes, or repeated attacks of gonorrhea, as the patient usually considers them, often constitute the most marked feature of the case. In fact, it is the rule in mild cases for the patient to be wholly unconscious that his urethra is at all narrowed. Gleet was the initial symptom of 238 of my cases.

Changes in the Stream.—As the stricture tightens, fresh symptoms are added. The gleet continues, *the stream of urine is small and irregular.*[2] *The last few drops of urine are retained in the canal,* both me-

[1] *Trans. Am. Assn. G.-U. Surg.,* 1915, x, 11.

[2] It is to be noted that while an impediment anywhere in a water-pipe (such as the urethra) modifies the *force* of the stream, the *shape* of the stream depends chiefly upon the shape of the nozzle (the meatus). Thus the shape of the stream, upon which so much stress is commonly laid, has no bearing on the diagnosis of stricture. It is modified by the meatus itself more often than by any other cause.

chanically by the obstruction of the stricture, and because the wave of blood, impelled by the contraction of the accelerator urinae upon the bulb in the final effort at clearing the canal, cannot pass along the corpus spongiosum, on account of the obliteration of its meshes at the point of stricture, and thus fails in its function of expelling the last few drops of urine from the canal. By this same obliteration of spongy tissue, erection is sometimes rendered imperfect and painful. Obstructed urination was the first symptom in 77 of my cases.

Frequent Micturition.—Next to gleety discharge frequency of micturition is the commonest symptom of stricture. It is due to one or all of the following factors, viz.: congestion from straining to overcome the urethral resistance, cystitis, polyuria due to renal congestion.

With the frequency there is more or less pain. This was the initial symptom in 61 of my cases.

Retention.—The congestion of the stricture may be kindled by a heavy dinner, a little excess in drink, or a chilling of the legs; the mucous membrane swells, the stricture closes, and acute retention of urine results. If this retention is unrelieved, the bladder becomes overstretched, and the case progresses like an acute prostatic retention (p. 294).

Retention may be the only prominent symptom. The gleet may not have been noticed, the gradual decrease in the size of the stream may have been ignored, when, after exposure, excess, or a carouse of beer, retention suddenly comes on. Such was the procedure in 31 of my cases.

Hematuria.—Exceptionally *hematuria* may be the most prominent symptom of stricture, indeed the only one noticed by the patient. (This happened 3 times in my series.) The bleeding comes from an ulcerated spot and may be quite profuse. The blood usually continues to drip after the close of micturition (urethrorrhagia).

Pain.—Pain on urination is due to prostatitis, cystitis, or retention. The pain is felt at the neck of the bladder, in the perineum, at the point of stricture, or near the glans penis.

Sexual Symptoms.—Excepting the impotence which results from grave stricture, all the other sexual symptoms that have been traditionally accredited thereto are actually referable to prostatitis, vesiculitis, or verumontanitis.

RESULTS OF STRICTURE

Hemorrhoids and Hernia.—The constant straining in urination keeps the hemorrhoidal vessels congested. This not infrequently results in an attack of piles or of rectal prolapse; occasionally, hernia occurs from the same cause.

Prostatitis, Vesiculitis, Epididymitis.—Prostatitis, vesiculitis, and epididymitis are common results of stricture.

Cystitis.—The inflammation of the bladder caused by stricture is usually superficial, but it may become parenchymatous. In neglected cases the bladder usually becomes concentrically hypertrophied (p. 367). When this concentric hypertrophy is of long standing the contracted bladder does not dilate with relief of the stricture: the frequency of urine persists unabated.

Stone.—Urinary calculus is a rare result of stricture.

Pyelonephritis.—Infection and dilatation of the ureters and kidneys occur as in prostatic retention.

RESULTS OF THE MALTREATMENT OF STRICTURE

The results of the maltreatment of stricture are hemorrhage, inflammation of the stricture itself, periurethritis, infection of the upper urinary tract, and false passage. Of these only the last requires detailed mention here.

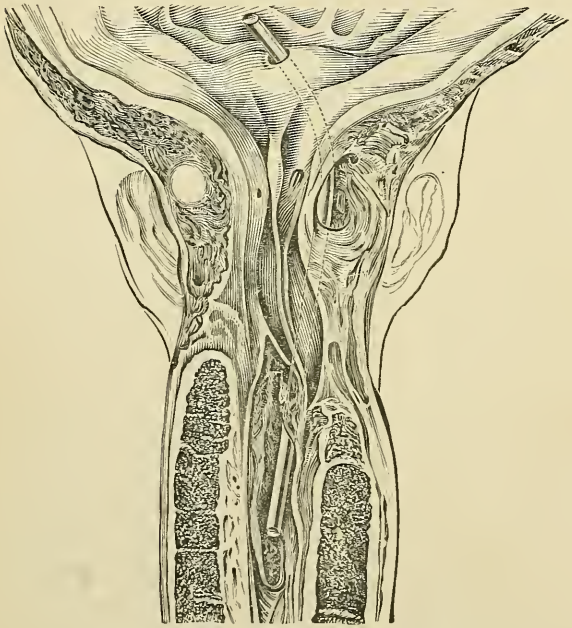


Fig. 50.—False Passage. (Dittel.)

False Passage.—False passage results from the rough or unskillful use of small instruments in an obstructed urethra (Fig. 50).

The surgeon making a false passage may be unconscious of the escape of the point of his instrument from the canal, but he soon perceives that it is behaving unusually. It is obstructed, but yet not held as though in the grasp of a stricture. The point, moreover, seems often to be turned out of the median line, and, after the instrument has been introduced far enough to reach the bladder, a rotary motion, imparted to the shaft, will show that the point is fixed in the connective tissue, and not freely movable, as it would be in the cavity

of the bladder. In such a case a finger in the rectum will feel the point of the instrument just outside the wall of the gut, at the apex of the prostate, or perhaps lying between the prostate and the gut. On withdrawing the instrument, blood flows freely from the meatus.

RESULTS OF NEGLECTED STRICTURE

In view of recent researches, many of the fundamental notions concerning infiltration of urine have been completely changed, and this condition and its associated phenomena now appear as inflammatory and not as mechanical complications of stricture. Since the time of Voillemier the accepted theory has been that all urethral dilatations and urinary pouches in the region of a stricture, as well as all urinary extravasation and infiltration, are due to the pressure of the urine forced against the weakened, inflamed urethra by the bladder filled to overflowing. The urine was supposed to burst through the urethra, and thus to cause these complications. But a certain number of phenomena are unexplained by this hypothesis. These are:

1. Urethral dilatations, abscesses and urinary pouches in front of the stricture. Such cannot be caused by any urinary pressure.

2. Urinary extravasation or gangrene caused by strictures of large caliber, when the back pressure is by no means sufficiently violent to cause rupture of the urethra.

Moreover, in direct contradiction to the theory of acute extravasation are the observed facts that:

1. The more the bladder is distended the less able is it to exert any great force or to produce more than a dribbling stream, even after the urethral right of way has been re-established.

2. When a urinary pocket is opened, and its urethral orifice found, the urine never gushes out, but flows drop by drop.

Indeed, Escat[1] and Cottet[2] go so far as to deny that the clinical picture of mechanical extravasation exists. The terrible straining and agony suddenly relieved with a feeling of something giving away in the perineum, and soon followed by extravasation, is, it would seem, a description devised to fit a theory.

The inflammation assumes one of the following types:

1. Suppuration within the stricture causes *periurethral abscess,* which:

a. Remains localized and quiescent.

b. Is absorbed.

[1] *Guyon's Annales,* 1898, xvi, 897 and 1026. This article is a detailed and brilliant elucidation of the whole subject.

[2] *Ibid.,* 1899, xviii, 590.

c. Extends into the perineum and scrotum.

d. Opens into the urethra and—

1. Discharges and heals.
2. Remains as a fibrous sac filled continuously or intermittently with urine, and communicating with or shut off from the urethra. (*Urinary pouch.*)
3. Fills with urine and bacteria, whose ravages rapidly spread the infection, causing *infiltration, extravasation, phlegmon, abscess, or gangrene.*

2. Suppuration on the surface of the sclerotic tissue, usually behind, sometimes at, and rarely in front of the stricture, may cause *dilatation of the urethra, periurethritis, periurethral abscess* (with the associated lesions just noted), or, if the physical and bacterial conditions are appropriate,[1] *gangrene of the urethra* alone or of the surrounding tissues as well.

3. To fill out and complete the theory that these accidents depend solely upon the combination of individual predisposition and bacterial virulence, two other conditions may be explained by it: the one, *malignant gangrene of the genitals,* a spontaneous gangrene extending over the genitals, sparing the deeper tissues, terminating in recovery, occurring in young subjects with genito-urinary history or disease, and quite comparable to noma, though not fatal; the other, *genital gangrene of old prostatics* long habituated to catheter life, a similar condition, not diabetic in origin, terminating in death (Guyon and Albarran, quoted by Escat). These rare conditions can arise from no source other than a fortuitous combination of soil and seed, comparable to that presented by gangrenous extravasation.

Periurethritis.—In almost any long-strictured urethra there can be felt, by introducing a sound and palpating the canal against it, irregular masses of cicatricial tissue occupying more or less of the whole length of the canal. A sensitive nodule in this mass indicates an area of periurethral inflammation that may, at any time, develop into an abscess.

Periurethral Abscess.—With the onset of suppuration in this tissue there is a sharp, septic febrile reaction. The lump grows rapidly larger, more painful, and tender, and it may encroach upon the urethra sufficiently to cause retention. Ultimately it opens into the urethra, or passes into a chronic stage, or more commonly extends into the perineum, burrowing thence throughout the subcutaneous tissue of the external genitals, the thighs, the groins, and even to the lower belly, dis-

[1] Cottet quotes Veillon and Zuber's law: "No gangrene or putrefaction without anaërobic bacteria," and finds in all the cases examined by him that when anaërobic bacteria were present there was gangrene, and when they were absent, even with extensive infiltration, there was no gangrene.

charging at many points, and leaving the whole region a mass of fistulae, through which the urine escapes, perhaps not one drop passing by the natural channel. In these cases the patient makes water sitting, the urine escaping as though through the sprinkler of a watering-pot. Civiale reported such a case with fifty-two external openings.

Urinary Infiltration (*Periurethral Phlegmon, or Gangrene*).—Beginning as an acute or a chronic periurethral abscess, or as a gangrene of the urethral wall, the acute infective process rapidly spreads over the perineum and the genitals. The first sign is a tender edematous swelling in the median line of the perineum, which rapidly increases in size and spreads superficially in every direction. If there is gangrene this spreads with frightful rapidity. If there is not gangrene, the enormous edematous swelling, which may reach the size of a child's head, breaks up into innumerable foci of suppuration, from which pus, and, later, pus and urine pour out. Accompanying all this are shock, severe septic symptoms, and usually retention of urine.

It is usual in these cases for the tumor to be extensively infiltrated with urine, and to contain one or more irregular central cavities filled with urine, necrotic tissue, and pus; but there may be no appreciable infiltration nor any communication with the urethra, and urethrotomy without a guide may be required for the purpose of relieving the retention.

The bladder never becomes gangrenous, though the urethra slough to its very neck. The suppuration and gangrene may leave a urethrorectal fistula, but the cavity of the pelvis is never invaded.

Inasmuch as urinary infiltration generally occurs in debilitated persons, and is itself a very virulent septic process, it often terminates fatally.

Urinary Fistula.—The periurethral abscess may open and discharge in remote regions,[1] but it usually opens in the perineum.

The internal orifice is usually single, however many the outward openings. The fistula, if long and tortuous or branched, contains diverticula which repeatedly close, form abscesses, and discharge; or they may contain foreign bodies or calculi, or the entire tract may be incrusted with calculus.

Prognosis.—Blind internal fistulae tend to close unless there is stricture. If they persist, they may form the starting-point for abscess or infiltration.

Blind external fistulae close spontaneously, or after cauterization or curettage.

Complete fistulae usually require operation.

[1] Desnos mentions a urinary fistula opening at the lower angle of the scapula. I have seen one that reached the loin.

DIAGNOSIS

Inasmuch as stricture is only an accentuation of the pathological process that constitutes chronic anterior urethritis, it may be diagnosed by the bulbous bougie. Any infiltration larger than 26 F. may be termed "chronic urethritis," if smaller, "stricture." But inasmuch as the tendency to contract is the essential feature of stricture, I prefer the sound to the bougie and term "stricture" only such infiltrations as grasp the sound (see below).

There are certain points in the history and urinary signs that are peculiarly suggestive.

History.—A history of prolonged mild intermittent gleet is peculiarly suggestive of stricture. Spontaneous urethrorrhagia is suggestive of stricture. Retention of urine is due either to stricture, prostatism, or paralysis of the bladder.

The Urine.—Large shreds in the urine are an indication of localized hard infiltrations in the anterior urethra, actual or potential strictures. These shreds may be obscured by free pus; but unless the stricture is controlled by treatment the urine always contains more or less shreds.

Diagnosis of Impassable Stricture.—When a filiform bougie cannot be passed to the *bulbous* urethra, there is impassable stricture.

If the bougie reaches the bulb but will not enter the membranous urethra, the obstruction is either stricture or spasm. An attempt is then made to pass the largest sound that will enter the meatus. If this is passed gently into the bulbous urethra and held against the face of the obstruction, it overcomes the contraction of spasm but absolutely fails to pass the stricture.

DIFFERENTIAL DIAGNOSIS

So much for the method of examination. The presence of an obstruction having been determined, the differential diagnosis lies between organic stricture, spasm, and chronic inflammation. The position of the obstruction and the various points dwelt upon in the preceding paragraphs, and in the chapter on Spasm, are elements in the diagnosis. But the most distinguishing characteristic of all is resiliency. Organic stricture is always elastic and resilient, the others are not. To test this resiliency a sound—the largest that will pass—is gently introduced through the supposed stricture. It is allowed to rest in place for a moment, and then an attempt is made to withdraw it. *If there be organic stricture the withdrawal of the instrument will be opposed by a firm grasping* as long as the instrument remains engaged in the stric-

ture. If, however, there be no grasping there is no organic stricture.

To tabulate these features briefly:

	Organic Stricture.	Spasm.	Urethritis.
Shreds or pus..	Always present.	Not present unless there is an inflammation.	Present.
Obstruction....	Always present.	Only in membranous urethra.	Sometimes.
Grasping.....	Always present.	No.	No.

CHAPTER XXVIII

STRICTURE OF THE URETHRA: PROGNOSIS AND TREATMENT

PROGNOSIS

The prognosis of stricture [1] depends upon the treatment more than upon any other one thing, but varies according to the nature and location of the scar. Traumatic strictures often contract rapidly, in spite of treatment. Gonorrheal strictures, on the other hand, contract far less energetically. Strictures of the perineal urethra are far more difficult to cure than strictures of the pendulous urethra. The latter contract slowly and are commonly curable by urethrotomy; the former contract more rapidly and are incurable—that is, they may be relieved by sounding or urethrotomy, but they almost inevitably relapse after a time. Finally, the more extensive a stricture, the more irregular its surface, and the denser the cicatricial tissue composing it, the more difficult will be its treatment and the more dubious its cure.

In the matter of life or death, however, the prognosis of stricture is far less gloomy. Stricture is very rarely fatal, except in neglected cases. Death occurs in various ways.

1. Periurethral phlegmon, which, if extensive, kills at once by shock, or, later, by exhaustion, suppuration, abscess, gangrene, or pyemia.

2. Urinary septicemia, the retention resulting in pyelonephritis or pyonephrosis. The patient may die from such a cause even after the stricture has been dilated, or, as is more commonly the case, the treatment itself, whether by sound or knife, may induce urinary septicemia which closes the scene.

3. Sudden death following the passage of a sound. Such deaths are extremely rare, and are apparently due either to the use of cocain, to *status lymphaticus,* or to nervous shock upon an impaired heart.

TREATMENT

Enlarge the urethra by dilatation, aided, if necessary, by cutting. Then maintain its caliber by dilatation. Or perhaps the negative view

[1] Cf. *Trans. Am. Assn., G.-U. Surg.,* 1915.

is more forcible. *Never cut if you can dilate; and recognize that the patient is not cured unless he stays cured.* Cutting is at best a substitute for dilatation, while divulsion and electricity are no substitutes.

PROPHYLAXIS

Since most strictures are caused by gonorrhea, and the occurrence of gonorrheal stricture is favored by the intensity and the duration of the inflammation, every effort made to control this inflammation is so much toward the prevention of a possible stricture. Yet this is but an indirect prophylaxis, since it is impossible to prophesy which case of gonorrhea will terminate in stricture and which will not. But when the disease becomes chronic *in the anterior urethra,* although there be no stricture present, the inflammation is encouraged by and is in turn encouraging a periurethral sclerosis, which may develop into a veritable stricture. Therefore, intelligent treatment of anterior urethritis is the surest preventive of stricture.

For traumatic stricture the proper prophylaxis is immediate perineal section at the time of injury (p. 528).

CURATIVE TREATMENT

Since the sound is the instrument best adapted to the cure of stricture, and since, unfortunately, it is easier to use a sound wrongly than rightly, a few words on the use and effects of sounds are required.

The surgeon attacking a stricture of the urethra may fairly analyze the therapeutic problem thus: "Here is a scar with a congested surface; shall I cut or shall I massage it?" If he cuts through it the symptoms are relieved, the obstruction is apparently removed, but the scar is still there. In fact, there is rather more scar than ever, and if the former scar contracted and gave trouble, so much the more will this one. To prevent this he will keep the lips of the wound separated by sounds, so that it may heal with so broad an insertion band that the contraction will be of no moment. Such a course will succeed in the pendulous urethra; but if the stricture is in the perineal urethra and of such density as to give the shadow of an excuse for cutting, it will certainly relapse after the operation unless subjected to systematic massage by sounds. The knife only relieves the congestion plus a temporary relief of the contraction, while the sound actually causes the resorption of the exudate. The effect is quite comparable to the effect of massage applied to the outside of the body. Moreover, *the maximum of effect is produced by the minimum of effort,* or, as Guyon puts it, "the effect is due, not to the pressure of the sound, but to its mere contact."

It is a matter of everyday experience that the brutal passage of a

sound, bruising and tearing the congested urethra, is followed by a sharp inflammatory reaction, which increases rather than diminishes the exudate. Such treatment is inexcusable. The stricture is already congested, the mucous membrane already inflamed. What more futile procedure than to add irritation to irritation! Such is not the object of the sound. On the contrary, the sound, if a metal one, should slip in almost by its own weight; slowly indeed, but surely. Such a maneuver has the treble effect of lessening congestion at the point of contact, straightening out irregularities in the canal, and stimulating the deeper tissues to a favorable reaction, which will result in softening the cicatrix. But to do this the sound must press without bruising. If a given sound will not pass, try a smaller one. The effect is readily judged. If a sound is properly introduced, it may usually be followed by sounds of the next larger sizes with less pain than the first. Larger sounds may be introduced at each sitting; the rapid amelioration of the symptoms shows that the congestion is relieved, the obstruction is disappearing, and the canal is resuming its normal condition. Yet, however gently a sound is introduced, it will be followed within forty-eight hours by a congestive reaction of more or less intensity. Hence, in treating stricture by dilatation it is bad surgery to introduce instruments—unless filiforms—before the lapse of seventy-two hours, and even longer intervals will often produce better results.

Lastly, and above all, gently, *gently,* GENTLY!

TREATMENT OF VARIOUS KINDS OF STRICTURE

The treatment of stricture at the meatus and of spasmodic stricture has been dealt with. Apart from these, the treatment of stricture may be considered under the following captions:

1. Stricture of large caliber.
2. Stricture of small caliber.
3. Stricture admitting only a filiform.
4. Stricture complicated by retention.
5. Impassable stricture.
6. Traumatic and resilient stricture.
7. Stricture complicated by prostatitis. (Irritable stricture.)
8. Stricture complicated by false passage.
9. Stricture complicated by periurethritis or prostatic abscess.
10. Stricture complicated by fistula.
11. Stricture complicated by acute pyelonephritis.

1. Treatment of Uncomplicated Stricture of Large Caliber.—After the diagnosis has been made by the passage of a bulbous bougie, no further instrumentation is advisable (if the patient can spare the time) until the effect of exploration has been observed. The chances of

urethral chill after the first examinations must be remembered. The patient's general condition and habits must be studied, and his urine tested for acidity or possible kidney disease. He must be instructed in urethral hygiene, the nature of his malady must be explained, and, to forestall future disappointment, he should be informed at the outset that, after his symptoms have been relieved by treatment, the permanence of his cure, *if his stricture is deep in the urethra,* may depend upon his use of an instrument upon himself at proper intervals, in order to prevent recontraction.

Being instructed not to mind the smarting at his next urination, a few drops of silver nitrate are instilled, and the patient is instructed to take a tablet of hexamethylenamin after each meal and to return in two days for dilatation.

Sounds.—The treatment best adapted to the majority of these cases is dilatation with a conical double taper steel sound. One of these instruments properly warmed and sterilized is introduced in the manner already detailed. Its size should correspond to that of the bougie that has passed the stricture, and the utmost delicacy, care, and gentleness should be used in its introduction. As soon as the instrument has entered the bladder it should be gently withdrawn at once. Nothing is gained by leaving it even for a moment. During withdrawal the stricture is usually felt to grasp the sound. After one sound has been withdrawn, a second and even a third may be introduced, if considered safe. It may be stated as a rule, subject to judicious exception, that *if a conical steel instrument of any size larger than No. 15 F., when held in proper position, will not enter a stricture almost by its own weight after a little delay, it should not be used.* Every urethra, however, has its own temper; some are aroused by the slightest disturbance, while others bear considerable violence without protest. A surgeon should acquaint himself by gradual experiment with the temper of a given urethra before he takes liberties with it.

The mischief to be feared from the employment of large sounds with force (besides false passage, which is not likely to be produced by large instruments) is threefold:

1. Epididymitis, a common result of violence to the urethra, and a complication which suspends treatment and confines the patient to bed for several days or weeks.

2. Inflammation in the stricture, which aggravates its condition and defeats the end of the treatment.

3. Chill and urethral fever.

The third danger, the chill and fever, is very unusual after manipulation of the pendulous urethra—witness the impunity with which many surgeons cut far and wide through that part of the long-suffering canal—and increases as we approach the bulbomembranous junction. Some

persons have a predisposition in this regard, and the presence of some renal lesion is essential as a predisposing cause of any real septic chill. Yet in no given case can the prognosis be definite, and the only safety lies in hedging the operation about with all possible precautions.

The rule which I have found most efficacious is:

Hexamethylenamin before,

Gentleness during,

Nitrate of silver or permanganate of potassium after sounding.

At each subsequent visit of the patient, the surgeon commences with a sound from one to two sizes smaller than the last instrument introduced at the previous visit, and carries the dilatation as far as possible without the employment of force, till the full size is reached.

The Interval.—The most important feature in the treatment of stricture by dilatation is a proper regulation of the intervals to be allowed between the visits. The intervals usually recommended are too short. We can only repeat that *it is bad surgery, in treating stricture by dilatation, to reintroduce instruments—unless filiform—before the lapse of at least seventy-two hours, and even longer intervals will often produce better results.*

The Full Size.—As to the degree of dilatation which is to be aimed at, every urethra has its own gauge in the size of its meatus—provided that meatus be not congenitally small, or contracted by disease. If there is any cicatricial tissue in the circle of the meatus, or if a probe can make out any pouching below the lower commissure (Fig. 46), the meatus is too small.

In the majority of cases this physiological gauge—the normal meatus—is adequate. A stricture once dilated to this size—which will vary from 27 to 32 F.—will stand the test of a cure—that is, the inflammation about it (not necessarily the prostatitis) will rapidly disappear, and the stricture will not recontract during the lengthened intervals of sounding that constitute the after-treatment. But occasionally the meatus is too small a gauge. The outer fibers of the scar lie so deep and are so elastic that they are unaffected by the pressure and tend to recontract as soon as the lengthened intervals of sounding permit them to do so. Such strictures must be cut or stretched with the Kollmann dilator until a point is reached where they do not recontract.[1]

[1] Otis's Theory.—Such was the basis of Otis's famous theory. Meeting many strictures incurable by the half-hearted methods of dilatation then in vogue, and finding that a generous incision cured stricture of the anterior urethra, he evolved the theory that the urethra is an evenly calibrated tube whose size bears a direct relation to that of the flaccid penis. This ratio he fixed at 10 mm. of urethral circumference to every inch of penile circumference. Thus, a 3-inch penis should take a 30 F.; a 3½-inch penis a 34 F. The objection to Otis's theory is that it is incorrect. The urethra is no more an evenly calibrated tube than the ureter, the esophagus, or the bowel. Its size no more varies with that of the penis than does the

Dilators.—There is no question but that sounds of a size readily admitted by the meatus may be passed with less discomfort to the patient than any dilator. But if the stricture when dilated to the size of the meatus recontracts with undue rapidity, further dilatation may be performed by the Kollmann dilator. This instrument is employed in the same manner as in the treatment of chronic urethritis.

Urethrotomy.—If at any stage of dilatation the stricture rebels and can not be dilated any further, urethrotomy must be resorted to.

Choice of Urethrotomy.—External section is best suited to strictures of the bulb, internal section to strictures of the pendulous urethra. There still remains a choice of instruments for internal urethrotomy, which choice is simply a matter of taste. For my part, I like the bistoury for strictures near the meatus, Otis's dilating urethrotome for any stricture of the pendulous urethra large enough to admit that instrument, and Maisonneuve's urethrotome only for those strictures through which an Otis instrument will not pass.

After-treatment.—The after-treatment depends upon the location of the stricture.

If the stricture is in the pendulous urethra, the surgeon may feel confident that a cure persisting three months will prove permanent. When the stricture has been dilated fully, so that there are no longer any large shreds in the urine (unless from the posterior urethra), the patient may be dismissed to report in two weeks. If at that time there is no recontraction, he may be dismissed for a month, and again for two months, when his cure may be pronounced permanent. If, however, there is a relapse on any of these occasions, visits must be renewed, and the patient's cure insured by higher dilatation or a further cutting.

If the stricture is in the bulb the matter is different. In all such strictures, except those soft bands that yield to one or two passages of a sound, recontraction will almost inevitably take place, unless the cure be maintained by the passage of a full-sized sound. This is easily done by the patient. In a few lessons he acquires the art of gently passing a sound upon himself, and he should be seriously cautioned to perform this trifling but important operation once or twice a year. If the sound fails to pass on some such occasion he must report for examination. In this way, in some cases, the use of instruments may be gradually abandoned; in the majority, it will have to be continued indefinitely, at intervals varying from a week to a year. Thus the cure becomes radical. The surgeon is responsible for the cure only on condition that the pa-

size of the œsophagus with that of the neck. The objection to Otis's practice is that it involves an unnecessary and harmful amount of cutting, since, as a rule, the patient can get well without it, and the operation may leave a canal defective in expulsive power. Moreover, though this wide cutting cures strictures of the pendulous urethra, it does not cure deep strictures.

tient carries out this plan; or, rather, the patient is responsible for the permanence of his own cure, and this he must be made distinctly to understand.

2. Stricture of Small Caliber.—To this class belong strictures admitting any instrument less than No. 15 F. They are considered separately, not because they require different treatment, but in order to emphasize the fact that they are better treated with soft than with steel instruments. The danger of making a false passage in an obstructed urethra with a small metallic instrument cannot be overrated. No one can appreciate the ease with which a false passage is made until he has himself made one. Indeed, a surgeon, not well acquainted with the urethra, may make a false passage, and go on dilating it instead of the stricture, wondering meantime that the size of the stream is not increased or the symptoms alleviated. Only a surgeon who knows every line of the urethra may occasionally assume the risk of using a small metallic instrument in the canal without a guide.

Dilatation is carried on as already directed, steel instruments being used as soon as the stricture will admit No. 15.

Urethrotomy.—Cutting may be resorted to:

a. If the stricture will not dilate.

b. If the patient has not the time to go through a long course of dilatation.

c. If urethral fever follows all attempts at dilatation.

3. Stricture Admitting Only a Filiform, but Not Complicated by Retention.—It may be impossible to enter the bladder with any instrument, either on account of the tightness of the stricture, or because the point of the instrument does not engage in the latter, or is arrested by some fold beyond. In these cases gentle perseverance and skill will rarely fail of success.

Preliminary Measures.—The very failure of larger instruments to pass, which tells us that filiforms must be employed, so distorts the orifice of the stricture as to make the passage of filiforms most difficult. Consequently only one or two brief efforts should be made at this time. If these fail further efforts should be deferred for forty-eight hours.

As a preliminary the urethra should be injected with anesthetic lubricant. This is preferable to oil or adrenalin.

Introduction of Filiforms.—Filiforms (p. 22) are apt to catch in the urethral folds and crypts both in front of and behind the stricture.

The following maneuvers are employed to overcome this difficulty:

1. When an instrument catches, partially withdraw and slightly rotate it, pushing it forward while making the rotatory movement. This device rarely fails in finally engaging the instrument in the orifice of the stricture, especially if the filiform point be bent or twisted so that

its extremity may lie outside of the axis of the shaft of the instrument.

2. An excellent method of finding the orifice of a stricture consists in cramming the urethra full of filiform bougies, engaging their points in all the lacunae and false passages, and then trying them, one after another, until that one is pushed forward which is presenting at the orifice of the stricture, when it will at once engage (Fig. 51).

3. If the point of the filiform passes the stricture but catches in the prostatic urethra, it may be lifted into the bladder by a finger introduced into the rectum.

4. Where filiforms fail a 10 F. urethral sound may pass by virtue of its curve. Only the expert surgeon may employ such an instrument with impunity.

5. If the stricture is a single band the face of which may be reached by the urethroscope, this instrument is introduced, the stricture wiped with adrenalin until it ceases to bleed, and a filiform then introduced, guided by direct ocular observation. This maneuver rarely succeeds where other means fail.

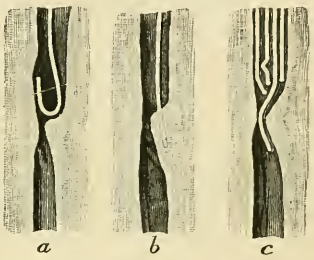


FIG. 51.—INTRODUCTION OF FILIFORMS. (Bryant.) *a*, guide bent upward; *b*, guide in lacuna; *c*, numerous guides in urethra, one passing stricture.

AFTER-TREATMENT.—After a filiform has been introduced the stricture is dilated to 10 or 12 F. When the patient is next seen, two days later, a 10 F. bougie will usually pass, or we may have to resort to filiforms again.

If drainage of the upper urinary tract is deemed necessary, a filiform may be tied in (p. 673).

4. Retention.—Acute retention requires immediate relief. The patient should be placed in a hot bath, more hot water being added after he has become accustomed to the first heat, and this carried as high as bearable. He should remain in the bath from fifteen to twenty minutes, and should attempt to empty his bladder while in the water. If the heat is sufficient to induce nausea or faintness, it is more likely to produce the desired effect of relaxing the stricture. Following this relief an attempt at dilatation should be made as described in the preceding section.

If these expedients fail, the bladder may be aspirated every eight hours for one day or drained by suprapubic puncture (p. 713). Then the patient is put into a hot bath for twenty minutes and a final attempt made to introduce a filiform. This failing, the stricture may be fairly considered impassable.

In drawing the urine from a distended bladder it is well not to remove more than 500 c.c. (℥ xvj) at a time. If there is more than this,

draw off the remainder after twenty minutes. Too quick emptying of an acutely distended bladder has been followed by hemorrhage, collapse, and even sudden death.

5. Impassable Stricture.—No stricture (congenital atresia excepted) is impervious unless the urethra has been cut across and all the urine escapes behind the cut, or unless the urine escapes through large fistulae. If a drop of urine can pass, the stricture is pervious. Our inability to pass instruments is due to the crookedness, not to the tightness, of the stricture.

How far the surgeon shall continue coaxing the urethra before resorting to external urethrotomy without a guide is a matter to be decided on the merits of each individual case. If the patient is difficult to manage, and there is fear that, once relieved from his present necessity, he may not submit to treatment, it is a kindness to take advantage of his misfortune by insisting upon perineal section at once.

But external perineal urethrotomy without a guide is a difficult operation, and is not to be undertaken lightly. If it is the patient's first retention, if he was previously passing a fair-sized stream, and if the bladder is not already too full, it is always well to try palliative measures. But, on the other hand, it is not wise to fritter away time to the permanent detriment of the patient's bladder and kidneys when a stroke of the knife would solve the difficulty.[1]

6. Traumatic and Other Resilient Strictures.—Traumatic strictures close down with great rapidity and are very rebellious to treatment. They are resilient. When dilated ever so little they recontract and often are made worse, rather than better, by sounds. Under such conditions dilatation is a losing game. The knife must be used. When the scar is linear, simple perineal section will suffice to render it amenable to the sound. When, as is often the case, the scar is annular and fibrous, all the scar tissue, both on roof and floor, must be cut away. The urethral wound may need to be closed by suture or graft, but that does not signify: the scar must be removed at all costs, since it never loses its retractile quality, and simple section will be followed by a recontraction almost as rapid as after the original injury. Cabot's resection (p. 734) is the ideal operation for such cases.

Other resilient strictures must be dealt with similarly.

7. Stricture Complicated by Prostatitis (*Irritable Stricture*).—Strictures classed as irritable in reality present no peculiar irritability in themselves, but they are complicated by prostatitis. As soon as the point of the sound or the bougie passes well through the stricture it glides over the prostatic urethra, the really irritable point—though, be

[1] Special instruments, such as Sinclair's retrograde cystoscope, devised to obviate urethrotomy without a guide, are so rarely needed that their use will never become general.

it understood, only the minority of strictures complicated by prostatitis are irritable—and provokes an exacerbation of the prostatic inflammation or a sharp chill. When such a complication presents itself the simplest solution is perineal section; but this is not always essential. By bracing the patient's general health, by employing rather large doses of hexamethylenamin, by using the utmost gentleness in sounding, by preferring bougies, which are less violent to the prostatic urethra than sounds, or else blunt sounds whose points need not enter the prostate at all, and by treating the stricture only sufficiently to permit local treatment of the prostatitis until the latter is materially improved —by such means operation may often be avoided.

8. Stricture Complicated by False Passage.—The treatment for a fresh false passage is to let it absolutely alone for two weeks, if the patient can urinate, and is in no pressing need of relief. Blood will flow for a day or two, then pus for a few days, and at the end of two weeks, in favorable cases, the passage opened by the instrument will often have closed.

In avoiding an old false passage, the seat of chronic suppuration, its position must be accurately studied, by observing at what point in the urethra an instrument engages in it, and from which wall of the canal (upper or lower [1]) it starts.

The orifice of a false passage once accurately located, may be subsequently avoided by making an effort to present the beak of the instrument at a different portion of the canal when passing the dangerous point.

If repeated attempts fail, or if suppuration and periurethritis intervene, perineal section should be performed without delay.

9. Stricture Complicated by Periurethritis.—There is no sane palliative treatment of periurethritis and its complications. The *simple inflammatory areas* should be treated by methodical soundings, perhaps aided by hot sitz baths and leeches to the perineum. Under such a course they rapidly suppurate or disappear.

Periurethral or Prostatic Abscess requires prompt evacuation and drainage by median perineal incision. The urethra should be opened and the stricture cut. In dealing with small abscesses this is a simple matter. Large ones should be cut and drained like infiltrations.

Infiltration of Urine demands immediate and radical incision. The patient's life is entirely in the surgeon's hands. Timorous incision is the patient's death-warrant. The infiltrated area must be slit open

[1] Guyon states that he never met a false passage on the roof, hence advises following that wall of the urethra to avoid it. I have, however, met two cases of false passage on the roof, as shown by external urethrotomy, and have seen one other with the urethroscope.

from end to end. Necrotic tissue must be sacrificed with no thought of ultimate disfiguration.

10. Stricture Complicated by Fistula.—The chief aim in the treatment of fistula is to remove the impediment to urination—to *dilate the stricture.* This done, the fistula may close. If it fails to heal promptly, perineal urethrotomy should be performed.

11. Stricture Complicated by Acute Pyelonephritis.—The kidney must be drained either by a retained catheter or by perineal section. The tube should remain in place until the temperature touches normal. This failing, nephrotomy is required.

SUMMARY OF TREATMENT OF STRICTURE

1. Hexamethylenamin, sedatives, alkalies, and rest are serviceable in some cases of stricture; indispensable if there be any serious complication.

2. All uncomplicated strictures, not highly irritable or resilient, should be treated by dilatation with soft instruments up to No. 15 F., and with conical steel sounds afterwards—reintroductions being made every fourth day.

3. Until well acquainted with the temper of a given stricture, every sounding should be preceded by hexamethylenamin, followed by nitrate of silver.

4. Dilatation need rarely be carried beyond the caliber of the normal meatus.

5. Any stricture resisting dilatation must be cut.

6. For the pendulous urethra, internal urethrotomy. For the perineal urethra, external urethrotomy or the combined operation.

7. In general, anterior stricture of the urethra is curable, deep stricture of the urethra incurable.

8. Impassable stricture without retention may usually be overcome with filiform bougies by time, patience, and skill. If finally proved impassable, the treatment is external perineal urethrotomy.

9. Retention is treated by hot baths; these failing, by aspiration, or by external urethrotomy without a guide.

10. Traumatic stricture may be prevented by section at the time of injury. Once having shown itself, it usually requires resection.

11. Resilient and inodular strictures are best treated by resection.

12. Irritable strictures may often be cured without cutting.

13. Acute inflammatory complications usually call for operation.

14. Unless secondary retention has occurred in the ureter or renal pelvis, drainage of the bladder by division of the stricture will relieve an acutely infected kidney.

CHAPTER XXIX

THE PROSTATE: ANATOMY, PHYSIOLOGY—PROSTATISM

ANATOMY

The prostate is a sexual organ, partly glandular, partly muscular, lying in front of the bladder and surrounding the prostatic urethra (Figs. 52, 65).

In *shape* the prostate is an irregular truncated cone. It has been aptly compared to a horse-chestnut. Its apex rests against the posterior layer of the triangular ligament. Its base, toward the bladder, is pierced above by the urethra, below by the ejaculatory ducts. Its upper (anterior) and lateral surfaces are rounded, its lower (posterior)

Fig. 52.—Sagittal Section of Prostate, Bladder Neck and Membranous Urethra. Division of gland by urethra and ejaculatory ducts well shown.

surface presents a boss on each side of the median line. It is to this lower surface particularly that the title heart-shaped or chestnut-shaped applies.

The *diameters* of the prostate, as given by von Frisch [1] (and Thompson [2]) are: length, 33 to 45 mm. (25 to 30 mm.); width at the base, 34 to 51 mm. (32 to 40 mm.); thickness, 13 to 24 mm. (20 to 25 mm.). Its *weight* is 16 to 24 grams. In *position* it is 8 to 12 mm. below the symphysis, and its apex is 30 to 40 mm. from the anus. Its long axis makes an angle of 20 to 25 degrees with the perpendicular.

The prostate is supported by the puboprostatic ligaments and the levator prostatae (anterior fibers of the levator ani).

It is fixed in its relations to the urinary organs by the urethra, which pierces it from base to apex, as well as by the decussation of its muscular fibers with those of the bladder and the urethra. It is separated from the pubic arch above and in front and from the rectum behind by a loose fascia, the fascia of Dénonvilliers, an offshoot from the pelvic fascia which passes down behind bladder, vesicles, and prostate, separating these from the rectum. Within this fascia and surrounding the prostate, especially in front, lies the prostatic plexus of veins.

Gross Anatomy.—The prostate may be considered as a gland divided into two parts by the ejaculatory ducts. These enter the gland at the posterolateral angles of its base, and run through it obliquely, opening finally into the urethra at or near the sinus pocularis. That part of the gland behind the ducts is called *the posterior lobe.* This part of the gland may become carcinomatous. It never becomes adenomatous.

The glandular tissue in front of the ejaculatory ducts is divided more or less arbitrarily into an anterior, a median and two lateral lobes. Lowsley [3] has shown that in fetal life these lobes are usually quite distinct. But after birth the glands of the anterior lobe usually disappear and the separation between the other three, lying behind and to each side of the urethra, is quite arbitrary. The median lobe may be inseparable from one or both of its lateral fellows. The median lobe of the normal prostate makes no projection from its surface. The "middle" lobe of prostatism is quite a different matter.

The prostate has a thin fibrous capsule.

Microscopic Anatomy.—The *muscular tissue* is arranged in so irregular a manner that no two observers are agreed as to its exact distribution. Walker [4] believes that the prostatic muscle is so arranged as to compress the gland as a whole, and each individual lobule of it

[1] Nothnagel's *Specielle Path. u. Therap.*, 1899, xix, ii, iii, 4.
[2] "The Diseases of the Prostate," 1883, p. 5.
[3] *Am. Jour. Anat.*, 1912, xiii, 299.
[4] *Johns Hopkins Bull.*, 1900, xi, 242.

in particular, but is not calculated to compress the urethra. This view is in accord with the fact that women—who possess no prostate—have complete control of the bladder without any additional muscle to take the place of this gland.

The *internal or involuntary vesical sphincter* (p. 36) is so intermingled with the muscular fibers of the prostate and urethra that anatomists differ as to its proper relation to the gland.

The *glands* are of the compound racemose type with cylindrical epithelium, which may be flattened by pressure or may appear in a double layer. They are collected into lobules (15 to 32 in number), each lobule surrounded by a layer of muscle and emptying by a duct into the lateral portions of the floor of the prostatic urethra, some behind and some in front of the verumontanum. All these ducts point toward the orifices of the ejaculatory ducts, so that the prostatic secretion is mingled with the semen at the moment of ejaculation.

A small but important group of urethral glands lies upon the floor of the urethra within the grasp of the sphincter. Occasionally a few similar glands are found upon the trigone (glands of Albarran).

The *arteries* are derived chiefly from the inferior vesical. The *veins* form the prostatic plexus. The *lymphatics* are very numerous. They pass to the internal iliac and obturator lymph nodes. The *nerves* are derived from the inferior hypogastric plexus of the sympathetic.

The Prostatic Urethra.—The urethra extends from the bladder downward and forward through the prostate, so that, although the major part of the gland lies below and behind it, the urethra emerges quite at the center of the apex of the prostate. The anatomy of the prostatic urethra has already been described (p. 35).

PHYSIOLOGY

The prostate is the sexual heart. It has nothing to do with urination, and is quite passive during this act.[1] But toward the sexual function it acts as a muscle, a sensory organ, and a gland.

As a *muscle* it acts to open the ejaculatory ducts, thus permitting the escape of the semen into the prostatic urethra, to express its own secretion into the prostatic urethra, and probably to expel it into the anterior urethra. The accepted function of the verumontanum—viz., to close the vesical orifice and prevent regurgitation of semen into the bladder—has been denied by Walker and others.

The seat of *sexual sensation* in the prostatic urethra is, perhaps,

[1] For the various aspects of this disputed question consult, besides the authors already quoted, Rehfisch, *Virchow's Archiv*, 1897, cl, 111; Finger, *Allg. Wien. med. Zeitung*, 1893, xxxviii, 427, 439, 452.

throughout its mucous membrane, but more probably it is confined to the verumontanum. When erection has been stimulated by friction of the glans penis the verumontanum becomes congested and irritated, perhaps by a spinal reflex, perhaps by the gradual influx of semen into the prostatic urethra, and ejaculation results.

The *glandular function* of the prostate is no less interesting. Besides acting as a simple diluent, it adds something to the semen that keeps the spermatozoa alive for several days, whereas other diluting fluids keep them alive only three or four hours.

The *secretion* of the prostate is a thin, turbid fluid of watery consistence, of slightly acid reaction, and of seminal odor. Its qualities in health and disease have already been described (p. 164).

There is probably an *internal prostatic secretion* that stimulates spermatogenesis.

PROSTATISM

Prostatism, miscalled prostatic hypertrophy, is an adenomatous or sclerotic condition of the prostate, causing obstruction to the outflow of urine through the urethra.

Although every adenomatous prostate shows areas of sclerosis and every sclerotic prostate adenoma, it is convenient to distinguish the common or adenomatous type of prostatism from the rare sclerotic type.

ETIOLOGY

Age.—Prostatism is a disease of later life. It rarely causes symptoms before the fiftieth year. Although individual cases have been reported at the ages of nineteen (Stretton), twenty-five (Englisch), thirty-seven (Thompson), etc., these are altogether exceptional. The pathologic changes begin early in life,[1] yet there is no clinical evidence of any such change until many years later. The patients begin to suffer, for the most part, between the ages of fifty and sixty-five.

Frequency.—According to Thompson's figures, 34 per cent of men reaching the age of sixty have enlarged prostates, and less than half of these (15 to 16 per cent of the whole) suffer from prostatism. This estimate is substantially accurate.

The size of the hypertrophy bears no relation to the age of the patient, nor, as we shall see, to the symptoms.

Pathogenesis.—Though no satisfactory theory has yet been ad-

[1] Gardner and Simpson (*Trans. Am. Urol. Assn.*, 1913) found only one adenoma among 15 prostrates of men less than 40 years of age. They found five adenomata among 19 prostates of men between 40 and 50 and seven among 21 in the next decade.

vanced to account for prostatism, many ingenious suppositions have had ardent defenders, and so require at least a brief notice.

1. Arteriosclerosis (Guyon,[1] Launois [2]).—The lesion of the prostate is supposed to be only part of a series of senile changes affecting the whole urinary tract and associated with general arteriosclerosis.

Casper [3] and Motz [4] overthrow this theory by showing that sclerosis could exist without prostatism, and prostatism without sclerosis. The association of the two appears to be purely fortuitous.

2. *Fibromyoma* (Velpeau [5]).—Velpeau suggested that there exists a biological analogy between the prostate and the uterus, and a histological analogy between fibromyoma of the uterus and prostatism. Thompson [6] amplified and defended the theory, and it has received additional weight by the alleged effects of castration upon uterine myoma and prostatism.

This theory has been exploded by the recognition of the fact that the prostate is analogous to the uterus neither in development, in structure, nor in function, and that prostatism is not fibromyomatous, but adenofibromatous.

3. Sexual Senility (White [7]).—"The function of the testis, like that of the ovary, is twofold—the reproduction of the species and the development and preservation of the secondary sexual characteristics of the individual. The need for the exercise of the latter function ceases when full adult life is reached, but it is possible that the activity of the testis and that of the ovary in this respect do not disappear coincidently, and that hypertrophies in closely allied organs like the prostate and uterus are the result of this misdirected energy." The facts adduced by White cannot be denied; but his theory, based upon the false prostato-uterine analogy and the implied power of the testicle to cause prostatism, and devised to defend the cause of castration as a remedy for prostatism, is an assumption not borne out by the facts.

4. Congestion.—A chronic congestion of the gland has been considered by many the chief predisposing cause of prostatism. Many varieties of congestion have been insisted upon. Some authors incriminate a pelvic congestion, such as is caused by gormandizing and a sedentary life, and expressed by hemorrhoids. Others insist upon chronic urethritis or sexual excess; and a few would even blame a too strict continence.

Young has noted that most of his patients were married men.

[1] *Guyon's Annales*, 1885, iii, 148.

[2] "De l'appareil urinaire des vieillards," Paris, 1885.

[3] *Virchow's Archiv*, 1891, cxxvi, 139.

[4] "Structure histologique de l'hypertrophie de la prostate," Paris, 1896.

[5] "Leçons orales," Paris, 1841, iii, 478.

[6] "On the Diseases of the Prostate." Fourth edition, 1873, p. 53.

[7] *Annals of Surgery*, 1893, xviii, 152.

5. Inflammation. — Ciechanowski [1] alleges that prostatism, whether adenomatous or sclerotic, is essentially the same; that it is due to obscure, inflammatory processes originating in the stroma of the gland; and that the so-called adenomata and fibromata are secondary changes due to the dilatation of gland ducts and acini whose mouths are obstructed.

Liechanowski further notes the fact that the underlying stroma changes found by him in the prostates of old men are the same as those found by Casper in the prostates of young men who had suffered from gonorrheal prostatitis. Hence the corollary that perhaps the prostatism of old age is due to the gonorrhea of youth. This suggestion, tentatively set forth by Ciechanowski, has been seized upon by several writers as an unavoidable inference, and is by them flaunted to the great shame of the large and respectable army of prostatics.

In order to test this theory from the clinical side, I have collected [2] the histories of a great number of men who have reached the age of fifty after having suffered prolonged attacks of chronic gonorrhea, and cannot find that they show any special tendency to suffer from prostatism. This, taken in connection with the fact that every established genito-urinary practitioner can call to mind many prostatics who—he may be morally certain—never had gonorrhea, seems to establish the fact that the prostatic sclerosis is not necessarily gonorrheal, but may be due to the congestion of sexual excess or of continence, to gonorrhea, or simply to advancing years. Where chiefly to lay the blame we do not know; in the meanwhile let charity temper our provisional conclusions.

6. Neoplasm.—The consensus of pathologic opinion attributes the adenomatous changes to a true neoplastic process, the sclerotic changes to inflammation. We may, for the present, accept this theory, while awaiting decisive proof one way or the other.

It seems probable that whatever conclusion is reached in this obscure matter will be based upon the fact that the prostate tends to undergo retrograde changes with cessation of its sexual function, as do the uterus and the female breast. How far prostatism will be found attributable to this normal involution, and how far to neoplasm, to the inflammations of youth, and to the congestion of sexual excess, the future must determine.

MORBID ANATOMY

Microscopic Changes.—We may distinguish a diffuse, hard, fibrous type, and a type characterized by the growth of encapsulated adenomata.

[1] "So-called Prostatic Hypertrophy," translation edited by Dr. R. H. Greene, 1903. Cf. also Rothschild, *Berl. klin. Wochenschr.*, 1909, xlvi, No. 27. Also Wilson and McGrath, *Jour. Am. Med. Assn.*, 1911, lvii, 1601.

[2] *Jour. Am. Med. Assn.*, 1904, XLIII, 187.

No given example adheres strictly to either type; indeed, it is the rule to find each existing in different parts of the specimen: in one place a dense mass of fibrous tissue, and scattered everywhere enucleable tumors, large and small, the larger ones (Figs. 53, 54) complex in structure.

Fig. 53.—Adenoma Enucleated from a Hypertrophied Prostate.

It is to be noted that the fibrous changes do not result in any actual enlargement of the gland. This enlargement, whence the name "prostatic hypertrophy," is due to the adenomatous change, diffuse or circumscribed. This adenomatous change takes place in that part of the gland nearest the urethra,[1] whether laterally or below, and by its growth compresses the outer portions of the gland tissue to such an extent that these form a firm pseudocapsule from within which the adenomatous masses may usually be readily enucleated.

Exceptionally the fibrosis so predominates that enucleation is impossible, the diseased portions of the gland being so welded to its periphery by scar tissue that the whole organ forms one sclerotic mass. Such prostates usually show an actual contraction of the prostatic urethra and bladder neck.

Fig. 54.—Section of a Large Prostatic Adenoma, Showing Its Composite Character.

It is to be further noted, therefore, that enucleation of the enlarged prostate leaves behind the peripheral portions of the gland.

Macroscopic Changes.—1. The posterior lobe, behind the ejaculatory ducts, is not concerned in prostatism.

2. The "capsule" consists of this lobe plus the compressed peripheral portions of the other lobes.

3. When adenomatous changes predominate, as they do in 90 per cent of cases, the adenomata are usually found generally distributed in the form of two lateral and one middle lobe.

[1] Whether in the prostate itself or in the periurethral glands is not agreed (Cf. Gardner and Simpson, *l. c.; also* Motz, *Rev. clin. d'Urol.*, Jan., 1914).

4. Exceptionally the gross change is confined to one lobe, usually the middle.

5. These adenomatous cases show a dilated urethra.

6. The sclerotic cases, on the other hand, are due to a general sclerosis, producing a rigid tight ring at the bladder neck (contracture), and often a constriction of the whole prostatic urethra.

Desnos's [1] specimens ranged in weight from 23 to 85 grams. Much

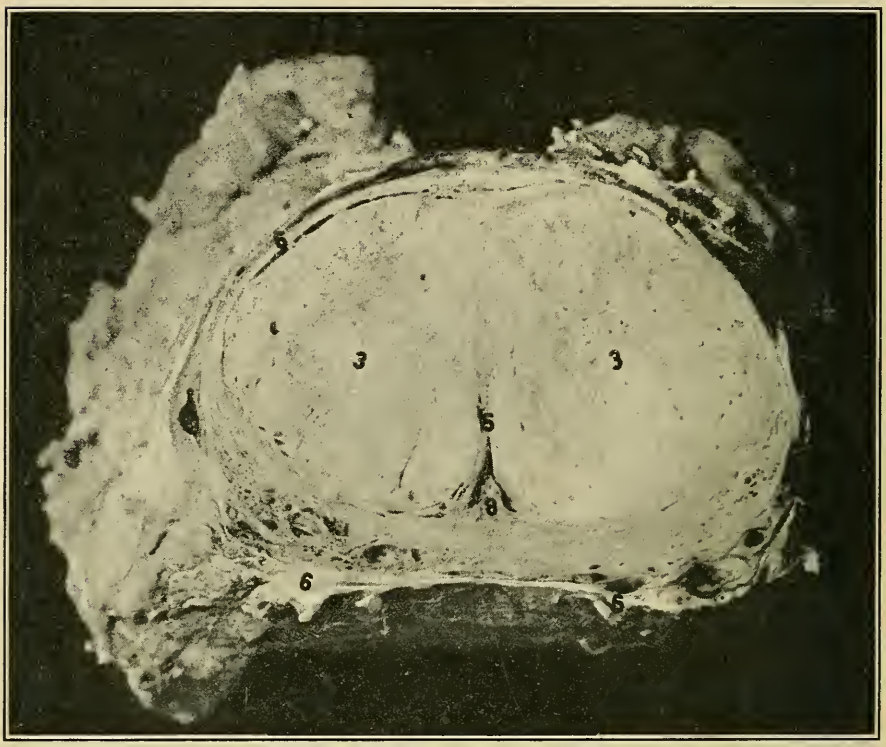


Fig. 55.—Prostatism; Transverse Section Showing Enlargement of Lateral Lobes. 3, Lateral Lobe; 5, Urethra; 6, 6, Capsule; 8, Verumontanum.

larger tumors are occasionally met with, but in the usual run of cases the prostate is much smaller than a mandarin orange.

The most notable gross changes associated with prostatism are (1) bulging of the posterior surface of the gland, (2) elevation of the urethral orifice, (3) production of a projecting middle lobe, and (4) lengthening and distortion of the prostatic urethra.

1. Posterior Enlargement.—In a large proportion of cases the lateral lobes of the prostate are enlarged. Such an enlargement may be felt by rectal touch. The examining finger, instead of impinging upon a scarcely perceptible organ, encounters a large mass, perhaps the

[1] Desnos, "Maladies des voies urinaires," 1898, p. 386.

THE USUAL TYPE OF PROSTATISM.

General prostatic enlargement, with middle lobe projection. Note position of verumontanum.

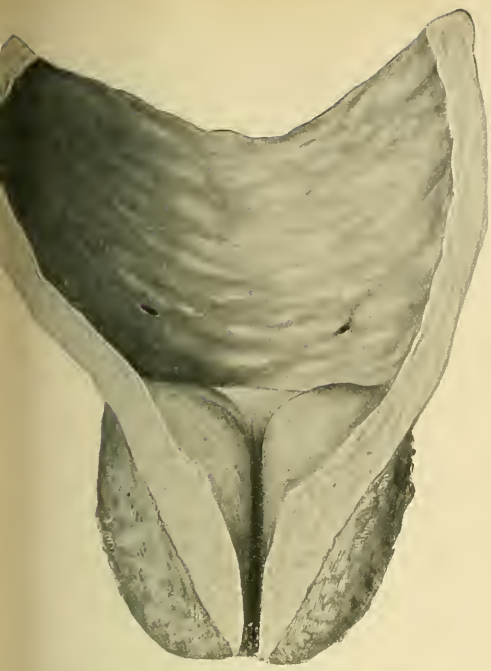


Fig. 56.—Bilateral Prostatic Enlargement.

Fig. 57.—General Sclerosis of the Prostate. The Contracture Type.

58.—General Enlargement of the Prostate with Median Bar.

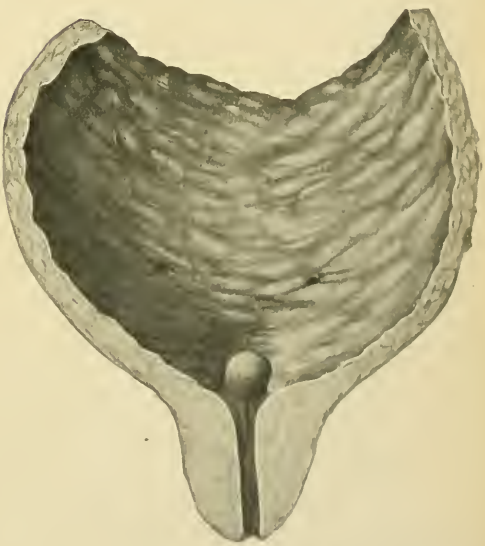


Fig. 59.—Pedunculated Median Enlargement.

size of a plum, perhaps so large that its upper border cannot be reached. To estimate the size of the growth the finger is swept over

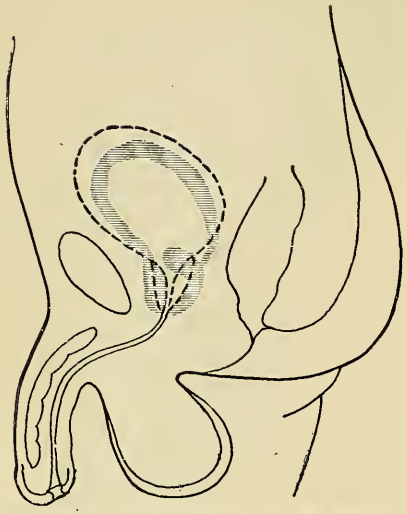


FIG. 60.—SAGITTAL SECTION OF FIG. 56.

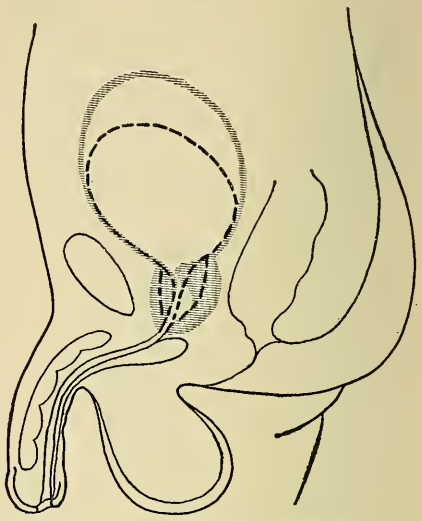


FIG. 61.—SAGITTAL SECTION OF FIG. 57.

it from side to side, into the sulci between it and the lateral wall of the rectum, and, if possible, over the top of the tumor. Its increase in all three dimensions may thus be fairly estimated and its general elas-

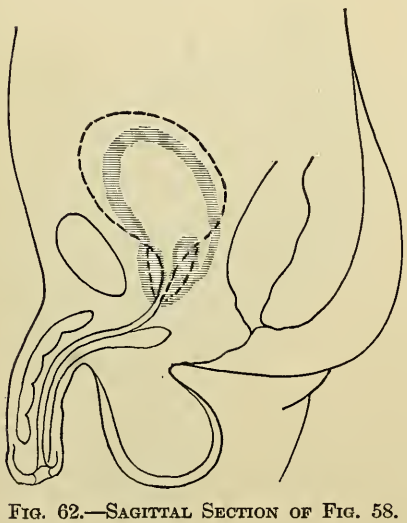


FIG. 62.—SAGITTAL SECTION OF FIG. 58.

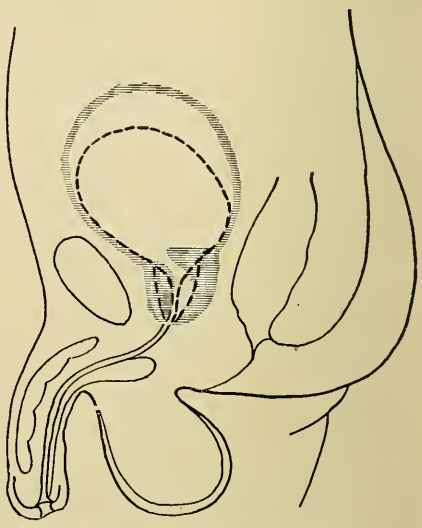


FIG. 63.—SAGITTAL SECTION OF FIG. 59.

ticity determined. In shape the mass is usually quite globular, but a little furrowed down the center. One lobe may be more hyper-

trophied than the other. Small phleboliths may be felt upon the gland.

2. Elevation of the Urethral Orifice.—When bladder and prostate are normal, the urethral orifice practically lies on the same level as the trigone and the floor of the bladder. But every form of prostatism disturbs this relation. If the growth is purely lateral, whether on one or both sides, the tumor lifts a fold of mucous membrane at the urethral orifice (Fig. 56). If there is general enlargement, the prostate projects upward into the bladder, pushing the urethra before it and forming the so-called *bar at the neck of the bladder* (Figs. 58, 62). The *middle lobe* (Fig. 59) acts in the same way. Finally, the fibrotic type (Fig. 57) of prostatism causes a true *contracture of the neck of the bladder,* with increased elevation of the urethral orifice.[1]

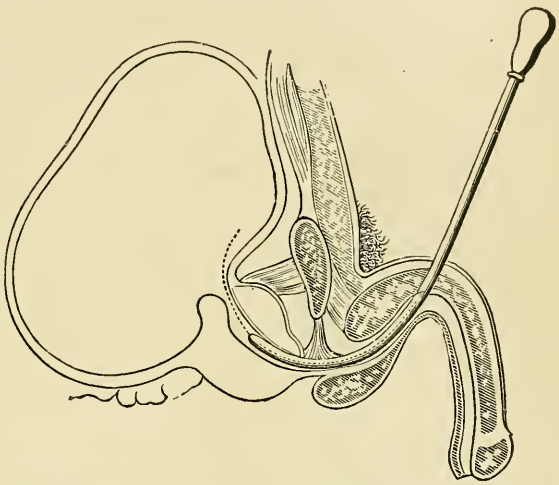


Fig. 64.—Section of Enlarged Prostate. Compare urethral curves in Figs. 64 and 65.

3. The Middle Lobe.—This term is loosely used to indicate any projection into the bladder, be it bar or tumor. Properly speaking, the middle lobe of the prostate is a distinct outgrowth from the neck of the bladder or from the floor of the prostatic urethra (Fig. 59). This tumor springs from the posterior commissure of the gland, and was supposed to originate within it. But Jores [2] showed that "its first beginning occurs in the accessory prostatic glands which lie just under the mucous membrane, and the projection into the bladder is due at first to the hypertrophy of these alone." These outlying glands are usually situated at the urethral orifice "directly beneath the mucous membrane and between the circular fibers of the bladder and the middle isthmus of the prostate" (Alexander [3]). The middle lobe is rarely more than 2

[1] Rochet ("Traité de la dysurie sénile," Paris, 1899) gives some space to the consideration of those unusual forms of hypertrophy in which the upper lobe is chiefly affected, and there is no elevation of the urethral orifice. Such a case was also illustrated in a previous edition of this treatise.

[2] *Virchow's Archiv,* 1894, CXXIX, 224.

[3] *Med. Record,* 1899, LVI, 982.

The observation of Tandler and Zuckerkandl (*Folia Urologica,* 1911, p. 1117) and of Motz (Marion, *Trans. French Urolog. Assn.,* 1911), tend to attribute all

cm. in diameter. It will be observed that some median enlargement is noted in 81 per cent of the tabulated cases.

4. Lengthening and Distortion of the Prostatic Urethra.—The prostatic urethra is altered in length, size, and curve (Figs. 60 to 65). *The urethra is always lengthened* by the increased size of the prostate. But the lengthening of the canal occurs between the verumontanum and the bladder neck and is more on the floor than on the roof (Pl. X).

The urethra is dilated chiefly by the growth of the lateral lobes which enlarge on each side of it and spread it out on a vertical plane, so that, from being a transverse slit, it is altered to a vertical one, with perhaps a curve to one side or the other, where a projection in one lobe fits into a depression in its fellow of the opposite side. The dilatation may be so great that an ordinary sound can be rotated quite freely within the canal, thus giving the false impression that the bladder has been reached. *The urethra is contracted* in purely sclerotic cases. *The curve of the urethra is lengthened.* That is, its internal orifice is carried upward and backward, and the canal, instead of having the short normal curve, sweeps in a curve of much longer radius, a curve that requires special "natural" catheters with the long curve (Fig. 64). The urethra is further deformed by the presence of the bar, below which the canal forms a distinct pouch, or by the projection into it of tumors from the various lobes, notably the middle lobe.

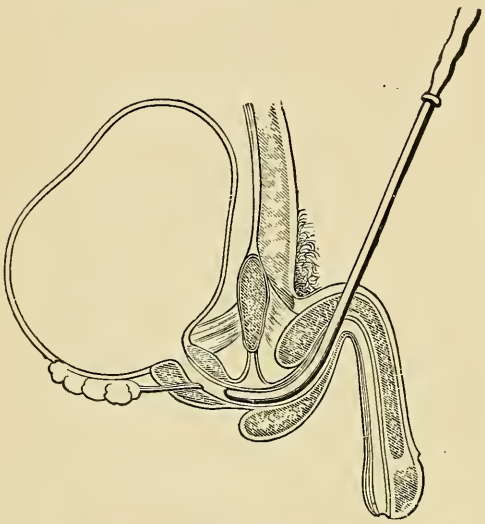


Fig. 65.—Section of Normal Prostate.

PATHOLOGICAL PHYSIOLOGY AND SECONDARY MORBID CHANGES

Retention, Congestion, Inflammation—these are the Fates of the prostatic.

Retention.—The causes of retention of urine are to be found both in the prostate and in the bladder. The prostate is primarily at fault. I do not remember to have seen retention of urine, whether complete or

prostatic adenomata, whether "middle" or "lateral," to glands adjacent to the urethra. We may reserve judgment until the dispute is settled.

incomplete, in any prostatic who had not some obstruction at the neck of his bladder, some elevation of the urethral orifice (whether such elevation was absolute or merely relative to the bladder), by bar, middle lobe, or contracture of the neck of the bladder. These changes about the urethral orifice disturb its physiological relation to the bladder. When in the act of urination the bladder contracts, it forces the urine over the prostatic bar with great difficulty; it is overstrained. To estimate the effects of this strain, the condition of the bladder at this time of life must be borne in mind. In the child the organ is ovoidal with the sharper end at its neck; it has no floor. But as adult life is reached it settles down into the pelvis. Its trigone becomes more and more horizontal. It acquires a floor. As age advances it tends to sag more and more. In the female it bulges down until it forms a cystocele. But in the male the bladder neck is supported by the urethral and prostatic attachments to the pubes, and, as the bladder sags, it thus tends to pouch behind the prostate, the trigone swings around until it forms the anterior incline of this pouch—the *bas fond,* as the French call it. While there may be some *bas fond* without prostatism, without obstruction of the urethra, such a *bas fond* has no clinical significance. But when there is urethral obstruction and heightened vesical tension at a time of life when the muscles are becoming fibrotic and losing their energy, the result is a relatively rapid pouching of the floor of the bladder, a general weakening of its muscle, and an inability of the organ to empty itself completely. The *bas fond* is never dry; there is always some urine left in the bladder; in short, there is *partial retention* of urine. It is as though the bladder were a tank with the outlet upon one side instead of at the bottom. However often the water is allowed to drain off from the tank none of its contents below the level of the outlet pipe can escape and the tank cannot be completely emptied.

As a result of this vesical derangement, and because of the low vitality of its dilated and inflamed parenchyma, the prostate, perhaps still bearing the scars of ancient battles with the gonococcus, is very subject to attacks of *acute congestion.* A Christmas dinner, an exposure to cold, particularly of the legs, a slight alcoholic excess, may bring on acute congestion in a prostate that has given no previous trouble. The patient may have had a little retention of urine quite unconsciously, until some day his acute congestion comes and he cannot pass water. Perhaps he succeeds in relieving himself by dint of hot baths and straining; perhaps his urine has to be drawn from him. The attack may be lasting, or transitory, it may or may not terminate in inflammation; in any case, it causes a temporary *complete retention of urine,* increases the chronic partial retention, and enhances the effects of this retention upon the upper urinary organs. And the constant pressure of the retained urine produces in turn a *chronic congestion* of the prostate.

The Bladder.—As a result of this retention of urine, the bladder not only changes its general shape but also becomes trabeculated, and even sacculated; while the cystitis causes a gradual sclerosis of the bladder wall, and even a pericystitis. As a final result, the bladder is left in that condition of atony described on page 367; though, if inflammation predominates over retention in the earlier stages of the disease, the interstitial cystitis may result in pseudohypertrophy. Stone in the bladder is a frequent result of prostatism.

The Ureters and Kidneys.—Dilatation, infection and stone effect the ureters and kidneys, as well as the bladder. With this difference, however, that the renal destruction, though the usual cause of the patient's death, progresses so silently that the victim does not suspect its existence.

CHAPTER XXX

THE SYMPTOMS, DIAGNOSIS AND PROGNOSIS OF PROSTATISM

SYMPTOMS

Inasmuch as prostatism causes no noteworthy symptoms until it produces retention of urine, the pathological changes in the prostate exist for years before the onset of symptoms; and the prostate may be much enlarged without provoking symptoms, so long as it does not cause retention. Thus, I have seen a man of 80 years of age, with a prostate four times its normal size, whose attention had been only recently called to his urinary organs by the symptoms arising from a secondary stone in the bladder. The presence of prostatism does not imply the existence of symptoms. Furthermore, the small sclerotic prostate may cause all of the symptoms that arise from the large adenomatous prostate. Indeed, the sclerotic prostate is likely to cause trouble earlier in life (much more difficult to relieve by operation) than its more familiar adenomatous fellow.

The symptoms of prostatism are:

1. Symptoms of retention, viz.: Frequent urination; urinary toxemia.
2. Symptoms of infection, viz.: Infection of the upper urinary tract; urinary septicemia; pyonephrosis; prostatic abscess; vesiculitis; epididymitis.
3. Hemorrhage.
4. Sexual symptoms.

Symptoms of Retention.—Nocturnal Frequency of Urination.—This is almost invariably the first symptom of prostatism. Even before there is any infection or any notable retention of urine in the bladder the patient has to arise several times at night to urinate. This irritation is usually most marked after 4 A. M., and, doubtless, is associated with that pelvic congestion which excites erections in younger men.

Painful and Difficult Urination.—During these hours of maximum frequency of urination, the patient recognizes an obstruction to the flow. He has to wait a long time for it to start, it comes in a feeble stream, and is slow to stop. The more he strains the less he is able to urinate, and he can often only empty his bladder by repetitious efforts.

As the amount of residual urine increases, or infection supervenes, urination becomes painful as well as difficult; frequent by day as well as by night.

Acute Retention of Urine.—As a result of overeating or drinking, exposure to cold and wet or, above all, voluntary retention of urine against the call of nature, the prostate may become suddenly so congested as to excite spasm in the sphincter and acute complete retention of urine. This may be relieved spontaneously, or by a hot bath, but usually requires the catheter. If neglected, it may kill the patient, or leave him in a condition of overflow.

Overflow.—True incontinence of urine, i.e., the involuntary loss of urine without filling of the bladder, does not occur as the result of prostatism. The loss of urine that does occur is overflow from the chronically overdistended bladder. This overflow is usually associated with irritation of the bladder, so that the patient urinates whether he will or no at least once an hour, perhaps oftener, and between urinations, especially during the night, he loses urine involuntarily.

Symptoms of Changes in the Upper Urinary Organs.—As a result of infection and dilatation of the bladder and the kidneys, the patient suffers from urinary toxemia, or urinary septicemia. His frequency of urination is increased by cystitis and stone in the bladder, and by the polyuria of renal dilatation.

Fever may be due to infection in the prostate, in the kidneys (pyonephrosis), or in the epididymes.

Hemorrhage.—*Bleeding is much more common from prostatism than from prostatic carcinoma.* The bleeding is due either to an ulceration on the surface of the prostate itself, or to secondary stone in the bladder. It may be of that profuse quality so suggestive of malignant neoplasm; it may occur quite independently of the passage of instruments.

Sexual Symptoms.—The combination of age and disease usually diminishes or obliterates sexual power and desire. Exceptionally, however, the congested prostate excites abnormal erections which may drive the patient into neurasthenia, or into all sorts of sexual excesses.

ONSET OF THE DISEASE

While the first symptom of the prostatism for which the patient consults a physician may be hemorrhage, a prostatic abscess, some sexual disturbance, or some other relatively unusual manifestation, the symptoms usually begin in one of three ways.

The Usual Type.—The symptoms begin with nocturnal frequency and difficulty of urination. This increases gradually and the patient

passes on through the first, second and third stages of the disease as described below.

The Acute Complete Retention Type.—Acute complete retention of urine may supervene at any moment in the course of the disease. It is the first symptom of importance in almost half the cases.

If promptly treated it may sometimes be relieved, and the bladder resume its ability to empty itself satisfactorily. But if the infection cannot be controlled, or if after relief of the acute complete retention some residual urine remains, the acute complete retention will soon recur. Very few patients with acute complete retention escape further trouble within the year. Yet they may escape for a number of years without any further symptoms.

Urinary Toxemia.—The patient with a tolerant uninfected bladder may never have an acute complete retention of urine and may not concern himself about his gradually increasing frequency of urination. He may thus reach a condition of chronic distention of bladder and kidneys without consulting a physician. Under such circumstances the first condition that he notes is a *loss of weight and strength, accompanied by constipation and dry mouth.* Even these he may not note until a slight infection adds fever to his symptoms. Such patients, unless carefully examined, may be treated for digestive disturbances for a considerable time; though the mere laying of a hand upon the lower belly identifies the distended bladder and intelligent investigation of the patient's history will reveal polyuria, frequency of urination and dry mouth.

COURSE OF THE DISEASE

The course of the disease is divided into three periods: The period of congestion; the period of partial retention; the period of complete retention. The two former may be introduced or interrupted by attacks of acute complete retention. Hemorrhage may occur at any time.

1. Congestion.—During this period there is little or no retention of urine, but only a slight nocturnal irritability of the bladder with often nocturnal polyuria and perhaps attacks of prostatitis or of sexual irritability amounting almost to priapism.

As a rule the symptoms are slight during this period unless there is acute complete retention. But either on account of nocturnal polyuria, stone or prostatic irritability there may be great frequency by night and sometimes also by day; although the amount of urine retained does not exceed 25 to 50 c.c.

2. Partial Retention.—The passage from congestion to partial retention, unless marked by an acute retention, is quite insensible. Residual urine begins to accumulate in the bladder, as a result not of an

enlargement of the prostate, but of weakening of the bladder muscle. The patient merely notes an added frequency of urination or, if infection occurs, a clouding or stinking of his urine, while the difficulty and pain in the urinary act increase and become diurnal as well as nocturnal. The limit of incomplete retention, both as to time and quantity, are quite indefinite. The patient who retains a pint of urine and yet has to pass water only every three or four hours and empties out six or eight ounces of urine each time cannot, strictly speaking, be said to be in a state of chronic complete retention. As a rule, however, by the time the patient's retention amounts to 250 c.c., his urinary calls are so frequent and the amount he passes so small that his bladder may be said to be full all the time. He is in the third stage of the disease.

3. Complete Retention.—With the occurrence of chronic complete retention, the bladder is practically full all the time. If contracted or badly inflamed this fullness may be reached with only 50 or 100 c.c. of urine. If dilated and uninflamed, 500 c.c. may be the measure of capacity. But the condition of chronic complete retention means frequent urination (every hour or less) the passage of small quantities (about 50 c.c.) and is always associated with dilatation of, and usually with infection of, the ureters and kidney pelves. If neglected the patient is unable to control his urination and is more or less constantly wet as the result of his involuntary overflow.

The back pressure has now made itself felt, the bladder is either dilated or contracted, but in either case the ureters and the kidney pelves are dilated, the renal parenchyma thin, the kidneys in a state of chronic congestion either infected or ready to flare up into acute inflammation with the first passage of a catheter.

The patient now, however careless, can neglect treatment no longer. The future course of his disease depends upon the treatment he receives.

VARIATIONS IN THE COURSE OF THE DISEASE

While the above description applies to many cases, the progress from one stage to the next may not be so systematic. Appropriate treatment may carry the patient back from the stage of partial retention to that of mere congestion, or from complete back to partial retention; or an isolated acute retention may be relieved and be followed by a long interval, even an interval of several years, during which the patient suffers not at all, and there is no retention whatever.

The *inflammatory complications* are, however, the chief agencies in modifying the course of the disease. These complications occur sooner or later in every case, and once the inflammation has set in it is almost impossible to get rid of it. *The inflammation is usually due to catheter-*

ism. Spontaneous infection does occur, but, as a rule, the complication is due to the surgeon's misfortune or fault.

Inflammation of the Prostate.—*Chronic prostatitis* is present in every infected case; indeed, the posterior urethra and the neck of the bladder are the places from which it is least possible to dislodge the inflammation. *Abscess and periprostatitis* are relatively uncommon. *Seminal vesiculitis* is common and usually unimportant.

Epididymitis.—Epididymitis may occur in acute attacks, spontaneous or following instrumentation, or it may appear as a sluggish, chronic induration at one end of the epididymis, with occasional subacute or acute attacks of recurrent inflammation. The epididymitis of the prostatic is especially prone to suppuration.

Cystitis.—Inflammation of the bladder is the most common and important complication of prostatism. The cystitis is usually due to catheterism, less frequently it is spontaneous. When due to the catheter, it usually begins acutely, often with a chill, while spontaneous cystitis is commonly chronic from the outset. Although the type of the inflammation may be severe throughout, the cystitis of prostatics is often of a mild and superficial type for many months, not causing any great pain or frequency of urination, or, at any rate, easily controlled by local treatment. The cystitis may be alkaline or acid.

Pyelonephritis.—No prostatic can have cystitis for any length of time without extension of the inflammation up the ureters to the kidneys. The pyelonephritis often remains for years a mild inflammation, recognizable only by a careful urinary examination; but, mild as it is, this inflammation is an aid to the urinary pressure in its work of debilitating the kidneys and slowly leading to the patient's death.

Stone.—The prostatic is peculiarly subject to stone in the bladder. Urate stones frequently complicate cases with but little retention and slight infection. Such stones are not visible to the x-ray. If removed by litholapaxy they recur repeatedly until the prostatic obstacle is removed. On the other hand severe ammoniacal cystitis is often a sign of phosphatic stone.

Hematuria, severe cystitis, and diurnal frequency of urination may suggest the presence of stone; but if this lies behind a large prostate it often does not irritate the bladder neck and its presence is not suspected until disclosed by cystoscopy or operation.

DIAGNOSIS

Rectal Examination.—When a patient over fifty years of age complains of frequent micturition, suspicion falls at once upon the prostate. It is rare that stricture causes trouble for the first time so late

in life, and even rarer for prostatic retention to occur earlier; moreover, with enlarged prostate, the inconvenience will, as a rule, have been first noticed at night—the reverse of what is observed in stricture. As the first step in the examination, a digital exploration should be made through the rectum. By this means alone prostatic hypertrophy can almost always be demonstrated. In place of the soft, chestnutlike body, hardly recognizable except by the skilled touch, the finger encounters a rounded, dense mass, smooth and usually symmetrical. The median fissure between the lobes may be more than usually perceptible, or may be wholly obliterated; while the finger passed up on each side, between the prostate and the walls of the pelvis, recognizes a deepening of the sulcus, an undue prominence in size of one or both lobes, an enlargement of the gland both from side to side and from above downward. If very large, it may be impossible to hook the last phalanx above the margin of the enlarged prostate.

If only the median lobe is enlarged, or if the prostate is sclerotic, rectal examination reveals no positive evidences of this enlargement.

Hypogastric Palpation.—If the bladder is distended with urine, an oval tumor is found, filling up the lower part of the belly, perhaps as high as the umbilicus, flat on percussion, and causing a desire to urinate when pressure is made upon it. This tumor, formed by the overdistended bladder, may sometimes be plainly seen, but the patient is usually unconscious of its existence. The full bladder may be palpated between a finger in the rectum and a hand on the hypogastrium.

The Urine.—The patient is now asked to stand up and to pass water into a glass vessel. As the urine flows the sluggishness of the stream is noted.

If there is complete retention, the urine will not flow at all, or comes only by drops. While the stream is flowing, if the patient strains, instead of becoming larger or flowing with greater force, it may be diminished in size and power. If the bladder be inflamed, there may be severe tenesmus and pain during the attempt to urinate, and the rectum may protrude or feces be passed during the act. Hernia may also result. At the end of urination the stream gradually dribbles away in drops, and often the final jet is wanting.

If the urine be now held up to the light, its cloudiness or limpidity proves an index to the presence or absence of urinary infection.

Catheterism.—If the urine passed is purulent, or if no urine can be passed, the quicker the patient is catheterized the better. But *if the urine contains no pus, infection will follow catheterism.* Hence the operation in such cases should be guarded by the most minute precautions, viz., hexamethylenamin, gentleness, antisepsis.

The choice of catheter is important. A smooth soft-rubber instrument will usually enter the bladder, but not always. A "natural curve"

woven catheter will enter the bladder of any prostatic whose condition is not complicated by previous efforts at instrumentation, or by carcinoma, stone or stricture. No force should be employed in introducing the instrument. Dexterity and patience will succeed where brute force will only light up inflammation or open a false passage.

The amount of residual urine measures, in a general way, the amount of retention, though this must be repeatedly verified.

The urethral length is also measured by the catheter.[1] One usually feels the resistance of the cut-off muscle very plainly in entering, and if the urethral length is not increased, one expects to strike water 5 to 6 cm. beyond. If the cut-off is not felt, one measures the total urethral length upon withdrawing the catheter. On account of the variable length of the anterior urethra the latter method is the less reliable.

In thus emptying the patient's bladder two rules must be borne in mind:

1. *Close the operation by a mild antiseptic irrigation* (nitrate of silver, 1:4,000).

2. If the bladder retains more than 500 c.c. of urine the result of emptying it with the catheter is likely to be a sufficient congestion of the bladder neck to induce acute complete retention. The patient's comfort and safety, perhaps even his life, depend upon the intelligence with which he is now managed during the first few days. Diagnosis merges immediately into treatment and neglect of this treatment may have fatal results.

3. The traditional danger of suddenly emptying a bladder that has retained more than a liter is real enough, but the cause of it has been misunderstood. The patient suffers, not because his bladder has been emptied, but because having once been emptied it is not kept empty. The first catheterization is usually performed with the patient lying down and he need only be kept upon his back until such faintness as he may feel from the relief of intra-abdominal pressure shall be relieved. But if the amount of retained urine is very great the back pressure upon the kidneys has been equally great and their susceptibility to immediate infection is proportional. The subsequent treatment, therefore, must be carried out with particular care, but the refilling of the bladder with enough fluid to minimize the supposed shock of emptying this organ is no part of that treatment.

Cystoscopy.—None but the expert should attempt cystoscopy in cases of prostatic retention. The operation is dangerous to the patient and is calculated to give little information to the unskilled manipulator. But to the specialist, cystoscopy is of the greatest service. It permits a more thorough appreciation of intravesical conditions than is attainable

[1] Special instruments devised for this purpose, such as those of Hagner and Cunningham, are not necessary.

by any other means; it searches for stone much more thoroughly than does the stone searcher; it also gives a very fair estimate of the form of the prostatic obstruction.

Cystoscopy should be performed only for the diagnosis of stone, or as a preliminary to operation. For the diagnosis of stone it is required in all infected cases. The introduction of the instrument may be exceptionally difficult on account of the prostatic obstruction, but this may almost always be overcome by depression of the ocular extremity of the instrument. The picture seen has been described on p. 62.

Urinalysis.—Inspection of the urine is an essential part of the examination. The specimen should, of course, be submitted to routine examination, and the division of a twenty-four-hour specimen into day and night is of great service in estimating the presence of nocturnal polyuria.

The phenolsulphonephthalein test and the estimation of blood pressure form a part of the routine examination.

The Phenolsulphonephthalein Test.—The condition of the kidneys is best estimated by the phenolsulphonepthhalein test. Even before the retention has become complete, this test shows some impairment of the kidney function and the output in the first hour after intramuscular injection usually varies between 25 and 35 per cent. Acute retention, if brief and promptly and completely relieved, has very little depressing effect upon the kidney function as tested by the phenolsulphonephthalein test. But chronic retention, however silent, greatly impairs the capacity of the kidney to secrete phenolsulphonephthalein. The typical hospital case enters the wards within twenty-four hours of the time that he has been more or less completely relieved of an acute retention capping a slight chronic retention of some years' duration. His kidney function may be as low as 5 or 10 per cent in the first hour, even lower. This is the red danger signal (p. 78).

Other Methods of Examination.—According to the information obtained, we examine the patient still further—palpate the kidneys, submit him to x-ray or ureteral catheterism, or to various renal function tests. For the fact that the prostate is large is of course the least important feature of the picture. The condition of the patient's bladder is more important than that of his prostate; the condition of his kidneys more important than either; the condition of his general health most important of all.

DIFFERENTIAL DIAGNOSIS

When a patient over fifty years of age complains of nocturnal frequency of urination we mentally set him down as a prostatic. Yet the inference is by no means strict. Surely two out of five cases of noc-

turnal frequency are due to other causes, such as nocturnal polyuria, prostatic carcinoma, or urethral stricture. The average prostatic begins to suffer between fifty-five and sixty-five, and first consults a physician at about the latter age. The patient who does not begin to suffer until after he is seventy years old usually has carcinoma. Moreover it is not to be forgotten that occasionally prostatic retention occurs in young men twenty or thirty years before the prostatic age.

Careful physical examination rules out such conditions as stricture and nocturnal polyuria. But four conditions causing the symptoms of prostatism are very commonly confused. Indeed, it may for a long time be difficult in a given case to make the diagnosis absolute among them. These conditions are:

Prostatism (adenomatous or sclerotic).
Prostatic neoplasm.
Paralysis of the bladder.
Prostatic calculus.

Prostatism may usually be distinguished from the other four as follows:

Prostatic Neoplasm.—To distinguish prostatism from prostatic neoplasm always requires careful rectal examination, sometimes cystoscopy, and occasionally the test of time (p. 315). Spontaneous hemorrhage is suggestive of prostatism rather than of malignancy.

Paralysis of the Bladder.—When there is retention of urine, but no urethral stricture, and no palpable prostatic enlargement, the following possibilities must be contemplated:

1. There may be paralysis of the bladder. This is commonly due to tabes, shows a rather suggestive cystoscopic picture, and is distinguished by the reflex changes and the examination of the spinal fluid (p. 469).

2. There may be carcinoma. Careful palpation then reveals nodules, and a thickening of the posterior lobe.

3. There may be a pedunculated middle lobe or a bar, visible by cystoscopy.

4. Rarest of all, and oftenest in relatively young men, we encounter the type of sclerotic prostate that shows no characteristic change to cystoscopy or to rectal touch. The existence of this condition can only be affirmed after tabes has been excluded by the most rigid tests.

Prostatic Calculi.—Inasmuch as prostatic calculi may give no subjective symptoms at all, or may produce only a vesical irritability, while for objective sign they cause enlargement of the prostate, it is quite possible to mistake calculi for prostatism. Yet I have not known this to be done; indeed, the irregular outline of the prostate containing many calculi is usually such as to suggest neoplasm rather than prostatism.

PROGNOSIS

In the First Stage.—Inasmuch as the majority have no symptoms at all, and an indefinitely large proportion of others have only slight symptoms for many years, one may be optimistic about the prospects of the prostatic who is seen in the first stage of his disease.

About 50 per cent of prostatics have acute retention, and the great majority of these reach chronic complete retention within five or six years. On the other hand, I have followed one case fourteen years, from his single acute prostatic retention, and seen no return of symptoms. A number of other cases I have followed more than five years. The younger the case, the slower the average progress of the disease. The prostatic who begins to have symptoms at or beyond the age of seventy usually reaches chronic complete retention within two years.

In the Second Stage.—When the patient is in chronic incomplete retention, his prognosis is gradual failure of the bladder and passage to chronic complete retention more or less rapidly, according to his age, his infection, the shape of the prostatic obstruction and the irritability of the prostatic urethra.

In the Third Stage.—When the patient has reached chronic complete retention, his expectation of life depends upon his treatment. The patient who refuses operation and neglects himself speedily comes to grief. The patient who takes care of himself may come to grief by unavoidable accident. But the passage of the catheter to empty a bladder in retention is not in itself necessarily fatal. Indeed, the patient who empties his bladder three or four times a day by means of the catheter is in no worse condition than the patient who empties his bladder the same number of times without a catheter, excepting only that the passage of the instrument is more or less irritating. I know a number of men who have employed a catheter with entire satisfaction for more than ten years, and one of my patients died of renal insufficiency after more than forty years of catheter life. Yet sooner or later, in spite of all our care, inflammatory or renal complications destroy the patient unless he submits to operation.

Prognosis as Regards Infection.—The prostatic who constantly passes the catheter is doomed to infection in spite of whatever precautions he may take. Aseptic rules of catheterism are solely for the purpose of making this infection as mild as possible. The infection always occurs within a month or two, usually within a week or two, of the beginning of catheterism. We look for it and are happy to see it pass, since it establishes the patient in a condition which either is, or may usually be reduced to, a mild acid cystitis.

The larger the prostate, the more likely is the infection to be difficult

to control. Careful patients with paralyzed bladders and complete retention without enlargement of the prostate do much better, as a rule, than prostatics; for the prostate is a constant source of infection and trauma.

Infection of the kidneys and ureters establishes itself at about the same time as infection of the bladder. It is quite as difficult to dislodge; but if the retention is well managed, so that the kidneys do not suffer much back pressure, it is easy to control for a time, at least.

Prognosis as Regards Kidneys.—Most prostatics who are not relieved of their retention by operation die by urinary septicemia with pyelonephritis. The issue may be rapid or slow. Watson[1] collected 207 cases of prostatism treated by the catheter, with a little less than 8 per cent mortality within a month. But the more usual danger from the kidneys is slow, insidious failure due to mild retention and mild infection.

[1] *Annals of Surgery*, 1904, June, p. 853.

CHAPTER XXXI

TREATMENT OF PROSTATISM

PROSTATIC HYGIENE

The prostatic man resembles the menstruating woman in that any exposure or overdoing reacts promptly upon his pelvic organs. "Beware of congestion" must be his motto, and upon this he must mold his life. He must avoid all exposure to cold: draughts are dangerous, wet feet fatal. His clothing, especially his underwear and footgear, must be regulated by the thermometer. Light exercise and fresh air are beneficial; but any excess—physical, mental, sexual, or alcoholic—must be avoided. Of alcoholic beverages, he may drink whisky, gin, and white wine in moderation; but preferably no beer or champagne. The stomach must not be overloaded. *"C'est souvent en lui souhaitant bonne fête,"* says Guyon, *"qu'on détermine chez un vieillard prostatique sa première rétention."* The diet must be both light and laxative, for a torpid bowel threatens infection as well as congestion. Meats should be largely replaced by vegetables and cereals. Finally, the patient must keep his urine bland by drinking plenty of water.

GENERAL TREATMENT

If the prostate is simply *congested,* the urine clear, the residuum negligible, there may be marked irritability of the bladder with frequent and painful urination. To conquer this, hexamethylenamin (0.5 to 1 gram), *t. i. d.* (though it may irritate), and sedatives are efficacious. Instillations of 10 per cent argyrol or 1 per cent phenol are also useful.

If there is *retention without infection,* the patient should be constantly on hexamethylenamin to prevent infection so long as any local treatment is being employed, and it is probably better that he should take a little of the drug at all times, if there is more than 50 c.c. of residuum.

If there is *infection,* the treatment is that of prostatitis or of retention cystitis, as the case may be. Hexamethylenamin is again the backbone of the treatment. It may be given for short periods of time

in doses as high as the patient can bear, in the hope of controlling the infection.

The treatment of renal infection is fully detailed elsewhere (p. 361).

The bowels and stomach often require special attention by cathartics, vegetable and saline, enemata, gastric lavage, etc.

Opiates.—A final word on the subject of opiates. Prostatism is a chronic disease, and pursues a most uncertain course. The sufferer, writhing in agony today, may be entirely relieved tomorrow. The patient whose last sun seems to have risen may be relieved by operation, and survive for many a year. Under these circumstances, it is scarcely necessary to insist that opiates should be administered with extreme caution. The patient, a constant sufferer from a tormenting disease, is in an ideal condition to become addicted to narcotics. I have seen few sadder cases than those of old men whose prostatic disease was still curable, while their subjection to narcotics could not be overcome.

LOCAL TREATMENT AND OPERATION

LOCAL TREATMENT

First Stage.—During the first stage of the disease the bladder empties itself. Catheterization is therefore quite unnecessary; indeed, it may be harmful. Bladder irritation must be treated by instillations of argyrol or carbolic acid, or by prostatic massage and the rectal douche. It is the relief of this condition, by the way, that is accomplished by the vaunted electrical, hydrotherapic and manipulative cures of prostatism.

Acute Retention.—The urine must be withdrawn. Half-hearted measures are inefficient. The hot sitz bath may be employed with a hypodermic injection of morphin as a temporizer; but the patient, once thoroughly obstructed, is quite beyond emptying his own bladder. The surgeon must do that for him.

There are only two requirements: (1) Absolute cleanliness, and (2) keeping the bladder empty. Under the head of absolute cleanliness must be included irrigation of the meatus before catheterization, and of the bladder afterwards, as well as the administration of hexamethylenamin.

After the passage of the catheter one gram of hexamethylenamin is administered as soon as possible and the dose repeated three times a day thereafter. The patient is immediately sent home to bed and if possible put under the care of a skilled nurse who promptly administers a hot rectal irrigation and is ready with the catheter in case the patient cannot urinate. If the patient urinates comfortably after one or two

catheterizations no further treatment is necessary so long as the bladder is found to empty itself.

But if the retention continues the patient must be disabused of the false hope that he can get along better without the catheter than with it. Quite the contrary is the actual case. The more he depends upon the catheter, the more likely is he to be relieved of his acute retention, or in case this is not to be, the safer he is in that retention.

The choice of the means of keeping the patient's bladder empty depends upon the circumstances. In my hospital practice I usually tie a catheter into the urethra of every case of acute complete retention, administer hexamethylenamin, keep the patient in bed, take a phenolsulphonephthalein test, and await the resulting infection. Within the next few days the patient has a rise of temperature, perhaps a chill or a series of chills, but if the catheter drains well and the bladder is irrigated with 1:4,000 silver nitrate solution, once a day, and hexamethylenamin kept up, the infective reaction (cf. p. 349) is likely to be relatively mild and brief, unless the patient's condition is very bad. In the course of a week, however, the phenolsulphonephthalein output drops with the advent of acute infection, stays low for a few days, and then usually, during the second week, begins to rise, reaches its previous height and often exceeds this. By the time the phenolsulphonephthalein output has become apparently stationary and any excessive polyuria has disappeared and the blood urea nitrogen, the blood pressure, etc., have been carefully examined, and a cystoscopy performed, the patient is ready for operation (which is always urged upon hospital cases). If the retained catheter does not work well on the hospital case, the bladder is opened above the pubes and drained until conditions become stationary.

In private practice it is usually more satisfactory to have an expert nurse pass the catheter as frequently as may be required, rather than to depend upon the indwelling catheter or the suprapubic drainage. During the first few days it is usually an excellent rule to have the catheter passed every time the patient feels the least inclination to urinate. By this time some system will have been established whereby the catheter can be passed at regular hours just ahead of the prospective desire to urinate. The bladder is washed twice a day, phenolsulphonephthalein test and hexamethylenamin administration conducted as above described. The patient is confined to the house but not to his bed. If he weathers his attack well and thereafter empties his bladder he does not absolutely need operation, though even he is perhaps better off if operated upon, since sooner or later retention will recur. But if complete retention continues I always ardently urge operation as a lesser danger than catheter life, unless the patient's general condition is such as to make the operative risk most unusually great.

A low phenolsulphonephthalein output is no contra-indication to operation, if other conditions are satisfactory and if the acute condition of renal reaction following the first catheterization has been passed. Indeed patients in catheter life who have long been infected and are accustomed to a certain moderate retention of urine may often be operated upon safely with almost no preparation whatsoever. It is the uninfected cases with acute retention that are likely to do badly by renal defect if operated upon too precipitately. One prefers to have the phenolsulphonephthalein test as high as possible before operation; but when this has become stationary, at whatever intensity, operation is justifiable.

Neither age nor debility are, of themselves, essential contra-indications to operation. Yet I confess to a certain human sympathy with patients 75 or 80 years of age. I prefer to let them have their few years of catheter inconvenience rather than to submit them to the turmoil of operation.

Catheter Life.—Patients by whom operation is refused or to whom operation seems unsuited may employ the catheter. Before this is agreed to cystoscopy should be performed so that one may be conversant with the conditions inside the bladder as to diverticulum and stone, as well as size and shape of the prostate itself.

The ancient rules as to the frequency with which the catheter should be passed are never followed by the patient. If the amount of residual urine is small and the bladder irritability slight the patient will refuse to pass his catheter more than once or twice a day. But as a rule he promptly goes into chronic complete retention and then should be urged to pass the catheter often enough to forestall urination. The traditional three times in the twenty-four hours are usually not sufficient; from four to six times are better.

The patient might add many years to his life by being aseptic and gentle, but the average man cannot be bribed into either virtue by the promise of longevity. He totally neglects asepsis and uses his catheter like the ramrod of a gun. Some urethrae will withstand a marvellous amount of such rough treatment, but the majority will not and their owners die miserably.

The patient should be instructed always to keep the head of his penis clean and to wash his own hands well before touching the catheter. He should use a rubber catheter if possible, keeping a number of these in stock, so that they may be all boiled together and laid between the folds of a sterile towel, to be carried about and used when necessary, one by one. In order to catheterize himself, the patient washes his hands, takes his tube of sterile lubricant, anoints with it the end of his catheter, mops the lubricant from the catheter to the end of the penis holding the catheter at a point at least two inches from its extrem-

ity and never touching those terminal two inches. He passes the catheter slowly into the bladder up to the point where it just draws water, holds it there until the bladder is empty, then withdraws it. Once a day he irrigates his bladder with 1:4,000 solution of silver nitrate using for this purpose a douche bag and filling the bladder to the point of comfort two or three times. It is preferable that the patient wash his bladder every day, for if any exception is made he will probably stop washing altogether. After the first acute renal infection has gone by, if he is faithful and gentle with his catheter and irrigation, I see no advantage in the administration of hexamethylenamin. Indeed the patient himself will soon desist from its use if it is advised. (Exceptionally, however, the hexamethylenamin keeps the patient clean better than the bladder wash.) The patient who has to use a woven catheter certainly ought to be operated upon or else have a trained nurse constantly at hand to pass the catheter. Otherwise he will simply punch holes in his urethra and cause both himself and his physician untold trouble.

RADICAL OPERATIONS

Obsolete operations—
- Castration and vasotomy.
- Bottini's operation.

Pseudoradical operations—
- Chetwood's galvanocauterization.
- Young's punch operation.
- Goldschmidt's and Bugbee's.

Radical operations—
- Intra-urethral perineal prostatectomy.
- Extra-urethral perineal prostatectomy.
- Suprapubic prostatectomy.

The Obsolete Operations.—Castration, vasotomy, and Bottini's operation have been, to all intents and purposes, discarded. Although the two former have manifest influence in the reduction of the congestion of the prostate gland,[1] it is questionable whether they ever cause the prostate to atrophy, and it is certain that whatever atrophy they do cause does not necessarily relieve the obstruction to urination, and has no effect upon the debilitated bladder.

Bottini's operation fails to fulfill the surgical indications. It is an attack upon the prostate undertaken through the urethra without digital examination of the precise nature of the obstruction, and without the possibility of verifying the fact that the obstruction has been relieved after the operation is completed. The surgeon does not know precisely what he is trying to do, nor precisely what he has done. The relief of

[1] Cf. Keyes, Jr., *Med. Record*, 1900, July 21, p. 81.

obstruction is scarcely ever permanent and even temporary relief cannot be predicted with any certainty.

Although the mortality of Bottini's operation is low (2 to 6 per cent), the cases that die are often those that could readily be saved by some other operation.

Pseudoradical Operations.—These operations pretend to remove small obstructions with a minimum danger to life. They all require a very special training and are appropriate for the relief of only the sclerotic type of obstruction. Chetwood's operation has a small risk of incontinence, but provides excellent drainage. Young's has the risk of bleeding and the advantage (or disadvantage) of permitting (or requiring) multiple operations. The trend of surgery is against all such procedures and in favor of prostatectomy.

Mortality of Prostatectomy.—The estimated mortality of perineal prostatectomy averages about 6 per cent (Proust [1] and Watson). Individual operators have reported a far lower mortality. Thus, Fergusson has reported 103 cases with 3.6 per cent mortality, and Young has performed 128 consecutive operations without a death, having previously reported 4.6 per cent mortality. Suprapubic prostatectomy has a rather higher average mortality. Thus, Freyer operated upon 1,000 cases with 6 per cent mortality. On the other hand, the average mortality of the specialist is 10 per cent, that of the general surgeon nearly 50 per cent.

Inasmuch as the technic of prostatectomy has only been perfected within the past few years, the masters of each particular operation are able to report a progressively smaller list of mortality, both because of the improvement of their technic and because they are able to recognize those cases which are in such bad condition as to justify no radical operation. No man attempts to remove the prostate of every prostatic. The more conservative operator may well succeed in saving all his patients, but only at the expense of permitting some to die of their disease, or to pass their remaining days with a suprapubic fistula, who might, in the hands of the bolder surgeon, have been rid of their troubles.

Functional Results of Operation.—Suprapubic prostatectomy gives the best functional results. If the patient recovers from the operation, and if the operation has been properly performed, he may be expected to become entirely well. He runs no risk of incontinence of urine or rectal fistula, is likely to empty the bladder completely, and careful after-treatment should minimize the one risk of the operation, viz., prolonged healing of the suprapubic wound. On the other hand, the suprapubic operation gives a much more tedious convalescence than perineal prostatectomy.

[1] *Comptes Rendus de l'Assoc. Franc d'Urol.*, 1904, p. 184.

Perineal prostatectomy, if entirely successful, is the most brilliant of all the operations upon the prostate. It permits the patient to be out of bed within a few days, and cures him entirely within two or three weeks; but it is a more difficult operation to perform properly than is suprapubic prostatectomy. It gives a small percentage of urethrorectal fistulae, even when performed by the best operators, and it leaves a small and indeterminate number of patients with incontinence of urine, partial or complete, after the operation. In short, more perineal cases survive, but fewer suprapubics wish they were dead.

The preservation or restoration of the sexual function has been falsely claimed as the crowning glory of each operation in turn. This can never be prophesied, has no bearing upon the integrity of the ejaculatory ducts, and is, after all, a minor consideration. Erections, if lost before operation, are rarely restored; if present, they are retained in about half the cases.

Choice of Operation.—If preliminary cystoscopy has not been, or may not be, performed, the suprapubic operation is the operation of choice, for it alone permits a thorough study of the precise nature of the intravesical growth and a full appreciation of the presence or absence of stone. Generally speaking, the surgeon unfamiliar with the technic of these various operations will succeed better by the suprapubic than by the perineal route. The pseudoradical operations do not guarantee a permanent cure.

CHAPTER XXXII

MALIGNANT NEOPLASMS OF THE PROSTATE[1]—NEOPLASMS OF THE URETHRA

Malignant disease of the prostate is almost always primary. Extension of a vesical cancer to the prostate is extremely rare, while extension of a prostatic growth to the bladder is not uncommon. Sarcoma occurs in youth, carcinoma in old age.

Sarcoma is extremely rare. Carcinoma of the prostate was found 43 times in 38,472 autopsies (Kuemmell[2]); 21 per cent of all prostatic lesions. The Mayo clinic reports 878 prostatectomies, of which 93 for carcinoma, while 84 other cancers were not operated upon. Young[3] reported that among 500 cases cancer was found once for every five cases of prostatism operated upon. Neuber[4] states that prostatic cancer forms from 1.42 to 2 per cent of all cancers.

Sarcoma.—Powers[5] has collected 31 cases, of which 14 were small round-celled or "mixed" growths. Of the 31, 15 occurred in children less than eight years of age (three of these in infants less than a year old), 8 between the ages of fifteen and twenty-five, and 6 between the ages of fifty and seventy.

The diagnosis is at times easy, at times difficult. A rapidly growing tumor of the prostate in a child or youth is probably a sarcoma. So, as well, is a rapidly growing, soft, balloon-like prostatic tumor in an adult. Pain is generally marked, and is referred to the pubes, perineum, and rectum. Urinary urgency is not generally present in the early stages. As in the case which forms the subject of this paper, an enormous growth may be unaccompanied by residual urine.

Prognosis in these cases is necessarily bad. In each of the authentic cases submitted to analysis by the writer either (*a*) the disease went on to a fatal

[1] No non-malignant tumors of the prostate have any clinical significance, other than the conditions described as prostatism in the preceding chapters.

Cysts of the prostate merit passing mention. The urethroscope sometimes discloses small cysts in the posterior urethra. They are not known to cause symptoms. They are readily destroyed by fulguration. Larger cysts have been found post mortem (Cf. Cunningham, *Surg., Gynec. and Obstet.*, 1915, xxi, 609). They obstruct urination, as do retrovesical echinococcus cysts.

[2] *Surgery, Gynec. and Obstet.*, 1915, xx, 274.

[3] *Ann. Surg.*, 1909, L, 1232.

[4] *Zeitschr. f. Urol. Chir.*, 1910, ii, 405.

[5] *Annals of Surg.*, January, 1908.

termination, or (*b*) the patient succumbed to operation or (*c*) to relapse after operation, or (*d*) the case was reported simply as an operative recovery. (Powers.)

Carcinoma.—Carcinoma occurs almost exclusively after the age of fifty. Thus Judd classes his 93 operated cases by decades, from 50 to 90 years, as 21, 34, 36, and 2 cases. He has seen a few cases before 50. The symptoms of the disease usually begin a decade later than those of prostatism.

Pathology.—The tumor is either medullary or adenocarcinoma. It may occur alone or in conjunction with prostatism. Geraghty found both in 75 per cent of his pathologic material.

It has been supposed that prostatism was the cause of prostatic carcinoma. This opinion was fostered by the absence of precise knowledge of the pathological differences between prostatism and carcinoma which led such competent observers, for instance, as Albarran and Hallé [1] to estimate that they found evidences of carcinoma in 14 out of 100 cases of specimens of supposedly non-malignant prostates removed at operation. These so-called carcinomata were found in the midst of adenomatous tissue, and have no bearing upon clinical carcinoma of the gland, for pictures closely resembling carcinoma can be found in many non-malignant pseudo-adenomata. But they are confined to isolated sections, and do not appear clinically as carcinomatous.

To Geraghty we owe the laboratory confirmation of the fact which has long been clinically evident enough that carcinoma and prostatism have no direct relation to each other. He has shown that if we leave apart these minute growths which might be called laboratory carcinomata, and consider only those that are grossly carcinomatous to such a degree that the pathological condition can at least be recognized in a gross section, *the carcinoma begins in a portion of the gland not affected by prostatism or adenomatous change.*[2] Carcinoma, therefore, has only this relation with prostatism that where the one begins, the other does not. Prostatism affects the lateral lobes and posterior commissure, as we know.

Geraghty found one carcinoma originating in the anterior commissure, and 49 originating in the posterior lobe (that part of the prostate which lies below the ejaculatory duct and is never affected by prostatism). This posterior lobe extends from one side of the prostate to the other. It is thickest at the apex, and thinnest at the base. It therefore lies between the examining finger and any other portion of the prostate, and if it is carcinomatous, it is impossible to distinguish

[1] *Guyon's Annales*, 1900, xviii, 113, 325.

[2] McGrath (*Jour. A. M. A.*, 1914, lxiii, 1012) does not wholly accept this contention.

by rectal touch whether the carcinoma is in the lateral lobe or elsewhere; one can only feel the presence of a hard nodule. The neoplasm extends in two directions—it first follows the ejaculatory ducts, breaking through the upper border of the prostate. Thence it slowly invades the trigone, but extends rapidly up between the bladder and the seminal vesicles, extending toward the lateral walls of the pelvis in the sheath of the vesicle so that the palpating finger from the rectum feels what seems to be a thickened and indurated vesicle, while at the same time

FIG. 66.—SAGITTAL SECTION OF PROSTATE ILLUSTRATING ORIGIN OF CARCINOMA. 1, Posterior Commissure; 3, Verumontanum; 4, Anterior Bladder Wall; 6, Fascia of Denonvillier; 7, Utricle; 8, Posterior Lobe, where Carcinoma usually begins; 9, Trigone; 88, Anterior Lobe; 0, Urethral Orifice.

the extension through the upper border of the prostate can be felt as a hard ridge along this (Fig. 66).

In the second place, the carcinoma extends into the lateral lobe of the gland itself, perhaps invading and replacing the lesions of prostatism there. The fascia of Denonvillier effectively prevents the extension of the carcinoma to the rectum until very late in the disease. The growth reaches the surface of the urethra and the bladder somewhat more readily, but even this progress is slow compared to its extension

within the pelvis. It is not uncommon for the carcinoma to cause retention of urine while no ulceration is present and no hematuria has occurred. If rectal stricture occurs, this is likely to be high up about the upper extremities of the seminal vesicles.

The pelvic and lumbar glands are involved early, so early indeed that the patient may die of glandular involvement or other metastasis before the carcinoma of the rectum has grown to sufficient size to be noteworthy.

According to Blumer[1] bone metastases occur in two-thirds of the cases that are not killed by operation.

Microscopical Diagnosis.—No amount of epithelial proliferation and piling up within the acinus is evidence of carcinoma of the prostate; for these changes may be brilliantly illustrated in simple prostatism. It is only when the epithelia break through the stroma that carcinoma can be diagnosticated. The pictures are often so confusing that only the most convincing evidence should be accepted, and this is usually confirmed by the gross changes.

Symptoms.—Cancer within the prostate gives either no symptoms at all, or only the vaguest and most unimportant perineal discomfort. Inasmuch as the primary growth may remain small for many years, bone or glandular involvement may predominate early in the disease.

Thus *bone involvement,* secondary to carcinoma of the prostate, may be the one clinical evidence of the disease during life; this occurs in a large minority of cases.

Sciatica and pelvic pain, due to involvement of the sacral plexus in the glandular metastases, is often one of the earliest symptoms. It may precede the urinary symptoms by several years. Bilateral sciatica in an old man is all but pathognomonic of prostatic carcinoma.

Abdominal tumor, due to carcinoma of the lumbar glands, I have once seen as the predominating early symptom in a patient who died without ever having any symptoms directly referable to his prostate beyond a very slight perineal discomfort.

Retention of urine, showing itself by frequency of urination, or acute complete retention quite comparable to that of simple prostatism, is often the first symptom of carcinoma of the prostate. The retention of carcinoma usually begins a decade later than that of prostatism.

Hematuria is a less common symptom in carcinoma than in simple prostatism. It occurs late for reasons already stated. It was noted in 22 per cent of Judd's cases.

Rectal obstruction and *ulceration* and *urethrorectal fistula* are terminal complications, as are *edema* of the extremities and genitals and *cachexia.*

Prognosis.—The disease is usually fatal in two or three years.

[1] *Bul. Johns Hopkins Univ.,* July, 1909.

The most rapid case I ever saw died within one year of the time that my first examination had left me in doubt as to whether there was a small nodule of carcinoma in the prostate or not. On the other hand, one of my cases took twelve years to die from the time in which I diagnosed carcinoma. No attempt had been made to remove the growth.

Diagnosis.—Prostatic carcinoma should be suspected whenever an old man has a bone tumor, sciatica or pelvic pain or urinary disturbances characteristic of prostatism.

The frequent association of prostatism with carcinoma obscures the diagnosis unless this is undertaken methodically. Young[1] has recently pointed out that in early carcinoma the patients are absolutely free from cachexia, and practically free from discomfort.

Rectal touch will usually disclose the presence of carcinoma of the prostate. Within the gland the neoplasm shows itself as one or more hard nodules, one of these being usually at the apex of the prostate. Such nodules are not pathognomonic; they may be due to tuberculosis, stone or ancient prostatitis. Unless other evidences of carcinoma are present outside the prostate, a diagnosis should never be concluded without an x-ray examination for prostatic stone, and an examination by rectal touch with a sound in the urethra. The presence of the sound brings out the great hardness of the carcinomatous nodule as well as the position at the very apex of the prostate where it joins the membranous urethra of the usual carcinomatous infiltration. Stone occurs only in the lateral lobes.

On the other hand, the most convincing evidences of carcinoma are those that appear above and beyond the prostate. The hard ridge just above its upper edge, extending outward and sheathing one or both of the seminal vesicles in a solid mass is the pathognomonic local sign.

Cystoscopy may reveal absolutely nothing. The first intrusion of carcinoma on the bladder is in the form of a bar. Infiltration and ulceration of the bladder neck and trigone are only seen quite late in the disease.

Urethral rigidity may, however, interfere with the introduction of the cystoscope relatively early.

Differential Diagnosis.—The diagnosis is difficult in two classes of cases:

The Tumor Is Overlooked.—This happens when the prostate is not thought of as a possible primary source of bone or abdominal carcinoma or as a cause of sciatica or retention of urine or when a careless examination of a prostate, actually containing carcinoma, fails to identify this.

There Is a Mass in the Prostate.—Distinct thickening of the apex of the prostate is apparently never due to anything excepting tuber-

[1] *Am. Jour. Urol.*, 1914, x, 251.

culosis in youth, and carcinoma in age. Indurations elsewhere over the lateral lobes may be identified as carcinoma by their great hardness and a negative x-ray, by the associated extraprostatic lesions, or by infiltrations seen by cystoscopy.

Treatment.—The radical treatment of carcinoma of the prostate is still indeterminate. Young is enthusiastic over total prostatectomy for the radical cure of those whose disease has not progressed beyond the limits of the gland. (It is, of course, absolutely impossible to guarantee the patient against a metastasis even at this time.) Pasteau [1] is almost equally enthusiastic about radium. A small experience with both procedures leaves us in doubt. Young's operation is very likely to result in incontinence of urine, though I have one case who made a good recovery and after a second operation—to close a perineal fistula—has complete control of his urine. I have seen brilliant mitigation of prostatic carcinoma by radium.[2] In view of the gravity and danger of operation the radium treatment is far preferable if it is employed with sufficient discretion to avoid burns.

The palliative treatment, as in all cases of carcinoma, consists primarily in avoiding operative interference as long as possible. If there is retention, the catheter must be employed, though the encroachment of the growth upon the urethra often makes catheterism difficult. In case the catheter fails, suprapubic drainage supplies relief of a sort, though the pelvic pains continue and the patient is likely to go rapidly downhill. On the other hand, there is a great array of palliative operations whose success cannot, unfortunately, be predicated beforehand.

Of every one of these operations it may probably be said with justice, that a very large proportion of them actually do no good to the patient. They may afford a temporary relief of symptoms, and this relief is likely to continue for several months, but no longer. Exceptionally the functional improvement lasts for several years. The few cases in which various palliative operations are alleged to have cured carcinoma of the prostate we may well refuse to pass judgment upon.

Each method of prostatectomy is praised as being especially adapted to produce extraordinary results with carcinoma. Each form of prostatectomy has, in turn, received this special praise—intra-urethral and extra-urethral, perineal and suprapubic. Bugbee has reported very satisfactory results from cauterization of the bladder neck with the D'Arsonval current. He has thus succeeded in reducing the amount of residual urine very considerably, and thereby increasing the patient's comfort. I have not as yet been able to duplicate his results.

While it is to be frankly admitted that radical cure is impossible

[1] *Canadian Practitioner and Review,* 1913, xxxviii, 703.

[2] Barringer, *Trans. Am. Assn., G.-U. Surg.,* 1916.

as soon as the carcinoma has exceeded the limits of the prostate, and improbable in any case, palliative operations are so much more likely to do harm than good, and so unlikely to do anything more than temporary good, that even in so desperate a condition as carcinoma of the prostate, it seems unwise to interfere unless the patient's discomfort is very great. If, however, the catheter totally fails to control the urinary difficulties, one may fairly waver between the confessed failure of the suprapubic drain, or the attempt to give temporary relief by prostatectomy. On the whole, I favor the drain.

CHAPTER XXXIII

ETIOLOGY OF INFECTION OF THE UPPER URINARY TRACT

The upper urinary tract consists of the kidneys and their ureters, the bladder, and the posterior urethra. The cut-off muscle separates the upper from the lower tract. The former is inside the body, as it were, and in its normal state entirely aseptic. The lower urinary tract —i.e., the anterior urethra of the male, the whole urethra of the female —is in no way separated from the integument, and may contain the bacteria that flourish upon the surrounding parts.

The flora of the anterior urethra have already been described in Chapter XVI.

Apart from prostatitis, the special characteristics of which have already been considered (p. 163), the infections of the upper urinary tract are:

1. Inflammation of the bladder: Cystitis, pericystitis.
2. Inflammation of the kidney, its pelvis, and the ureter: Acute renal infection, pyelonephritis, infected hydronephrosis, pyonephrosis, perinephritis.
3. Certain unusual types of inflammation: Incrustation, malakoplakia, leukoplakia, cystitis and pyelitis cystica and granulosa.

Inasmuch as the upper urinary tract is aseptic when in its normal condition, the three prime questions to be answered in regard to inflammations are:

1. What are the bacteria of urinary infection?
2. How do they obtain access to the urinary tract?
3. Why do these bacteria sometimes cause infection, and sometimes not?

BACTERIA OF URINARY INFECTION

Since the gonococcus, the typhoid bacillus, and the tubercle bacillus have, for obvious reasons, no statistical relation to the other bacteria causing infection of the urinary organs, and since they cause types of infection which are best considered separately, they are not included in the following data.

The most recent study of the bacteria found in the infected urinary

organs is that of David.[1] The cultures were obtained from cases of infection of various parts of the urinary tract.

Aërobes—
- 23 bacillus coli.
- 15 staphylococcus albus.
- 3 staphylococcus aureus.
- 5 bacillus enteritidis.
- 3 bacillus faecalis alkaligenes.
- 2 bacillus proteus.
- 2 bacillus pyocyaneus.
- 1 streptococcus.
- 1 bacillus pseudodiphtheriae.
- 1 unidentified Gram-positive diplococcus.
- 1 pneumococcus.
- 1 influenza-like bacillus.

Anaërobes—
- 4 black-pigment-producing bacilli.
- 4 Gram-negative, influenza-like bacilli.
- 2 staphylococcus parvulus.
- 1 Gram-negative coccus.
- 1 bacillus funduliformis.
- 2 Gram-positive staphylococcus.

The relation of the anaërobic bacteria to infection has not yet been determined. We shall consider only the aërobes.

It is to be noted that various bacteria may grow simultaneously in the urinary tract. The bacillus coli is usually a part of such mixed infections. It is further to be noted that certain of the bacteria separately listed in the above table may be grouped. Among the fifty-eight listed aërobes, bacteria of the colon group appear thirty-one times (53 per cent), staphylococci eighteen times (31 per cent), while the remaining bacteria may be classed as infrequent.

Scheidemantel [2] examined 100 cases with the following results: 89 colon group, 6 staphylococci, 3 proteus, 2 streptococcus, 2 influenza bacillus, and typhoid bacillus, a diplococcus, and the pyocyaneus, each once.

This represents quite closely the bacteria found in infections of the renal pelvis, while David's list represents more accurately those of infections of the bladder and prostate. In other words, *infections of the renal pelvis result almost always from bacteria of the colon group, while infections of the bladder are much more frequently due to the pyogenic cocci.*

On the other hand, every writer who has reported bacteriologic in-

[1] *Surg., Gynec. & Obstet.*, April, 1914, xviii, 432.

[2] *Muench. med. Wochenschr.*, 1913, p. 1722, 1913.

vestigation on perinephritis has noted the preponderance of the pyogenic cocci in the pus obtained from perinephritic abscess. Though the number of cases reported by any one observer is small, the universal agreement on the preponderance of *staphylococci and streptococci* in causing *perinephritic suppuration* is notable.

Virulence.—The available data do not suggest any particular virulence attributable to any specific bacteria or strain of bacteria. It would seem as though the virulence of bacteria depended most upon the accessory circumstances under which the infection occurs.[1]

Indeed experiments upon animals have amply proven two facts: In the first place, bacteria may be presented to the kidney in the circulating blood, pass through it and be found living in the urine, and yet leave behind no trace of their passage. In the second place, bacteria may be injected into any portion of the normal urinary tract, and cause no damage whatsoever. Clinical observations have confirmed these findings. Thus we may say that the occurrence of infection depends upon the simultaneous presence of bacteria and some accessory cause of infection.

On the other hand, one of the causes of intense infection is the bacterial splitting up of urea into ammonia and water. The ammonia is an irritant, and causes a much more severe infection (ammoniacal infection) than occurs when the urine remains acid. The chief urea-splitting microbes are the proteus, the pyogenic cocci, and sometimes the typhoid bacillus. These various bacteria show a marked difference in their tendency to split urea. Sometimes they do so, sometimes they do not. The accessory causes of infection have a marked influence in encouraging urea splitting. The colon group of bacteria, with an occasional exception of typhoid bacteria, do not split urea. A marked colon infection gives to the urine the odor of a dead mouse, but does not produce ammonia.

Crabtree believes that acute hematogenous kidney infection due to bacillus coli is a transitory lesion that merely lays the foundation for chronic pyelitis; while suppurating parenchymatous lesions are always due to the pyogenic cocci.

ROUTES OF INVASION

Bacteria reach the urinary tract through four routes:

1. The descending or excretory route.
2. The ascending or urethral route.

[1] This statement runs counter to all we know of the nature of infections. Yet with certain limitations it is true, and it serves to focus the attention of the practitioner upon the surgical features of these infections.

3. The lymphatic route.

4. Direct invasion by trauma or rupture of a neighboring abscess.

The Descending or Excretory Route.—Without stopping to debate the question whether or not the healthy kidney can transmit living bacteria in any number without injury to its secreting structure, we may accept as clinically proven, notably in the case of the typhoid bacillus, the fact that *living bacteria may enter the urine from a kidney clinically sound.* There is strong evidence for the belief that in the course of the various infectious diseases, even in tuberculosis, bacteria may be transmitted by the kidneys without leaving any appreciable trace of their passage through those organs.

Inasmuch as it seems biologically impossible for the living cell to transmit a living bacterium, it is probable that normal kidneys transmitting healthy, living bacteria, actually suffer a temporary localized inflammation so slight as to escape observation. Crabtree's [1] observations certainly seem to justify the theory that acute descending B. coli infection of the kidney, sufficiently intense to cause symptoms and to produce a marked temporary diminution of phenolsulphonephthalein output, may disappear so completely that a few weeks later the pathologist is unable to identify any lesions in the kidney.

Such acute temporary infections may perhaps occur in otherwise normal kidneys damaged only by the effort to excrete a large number of bacteria, while congested by the toxins of these very bacteria circulating in the blood. Such a combination would explain, for instance, the fact that about one case in four of typhoid fever suffers mild renal infection. Yet no relation has been established between the severity of the infectious disease, or of its toxemia, and the likelihood of renal infection resulting therefrom. Hence we cannot but ask ourselves whether even in these cases the one infected case out of four is not perhaps infected because of some local cause of lessened resistance in the kidney.

On the other hand, we must admit that colon infections at least are almost always bilateral. For the severe acute type of infection we can usually find a mechanical accessory cause. But for the milder infection of the opposite kidney we usually find no such cause. It is probable, therefore, that toxemia and massive doses of bacteria in the blood are the occasion of this opposite infection.

In order to explain the fact that pyogenic cocci are relatively common in perinephritic abscess, and colon bacilli relatively common in infections within the cavity of the kidney, Crabtree has evolved the ingenious theory that the pyogenic cocci exhibit in the kidney, as they do elsewhere in the body, a relative tendency to immediate pus production of considerable intensity as compared to that of the colon group.

[1] Cf. Cabot, *Trans. Am. Assn. G. U. Surg.*, 1916.

Reaching the kidney through the circulation, the pyogenic cocci set up their infection in the glomeruli, i. e., in the cortical portions of the kidney; whereas the colon bacilli are more likely to pass through the glomeruli, and to attack the tubules. Hence colon bacillus infection extends more readily to the pelvis of the kidney, coccus infection to the perinephritic tissue.

The sources of excretory renal infection are innumerable. The bacteria may be derived from focal infection (abscesses) in various parts of the body, or catarrhal infections of the various mucous membranes. The intestine is the usual source of bacillus coli infection, but the other bacteria are derived from roots of teeth, tonsils, adenoids, furuncles, accessory nasal sinuses, appendicitis, salpingitis, etc.

In the following section reasons will be given for suspecting that the bladder, the prostate, and the vagina are not uncommon sources of descending infection in clinical conditions that have heretofore been considered instances of ascending infection.

Urethral or Ascending Invasion of the Bladder.—The three methods by which microbes may ascend from the urethra to the bladder are:

1. Through instrumentation.
2. By extension upward of a urethral inflammation.
3. By spontaneous ascension of the urethral bacteria.

1. The passage of an instrument into a clean bladder is a frequent cause of cystitis. The gentle passage of a smooth, soft, clean instrument through a normal canal into a healthy bladder never causes cystitis. Perhaps bacteria are carried into the bladder by every instrument. Perhaps numerous pathogenic bacteria are introduced in this manner. But experiment and experience unite to proclaim that the healthy bladder is thoroughly able to sweep itself clean of these enemies. But this is not enough. The bladder may be thus protected, but not so the posterior urethra. Not to mention the gonococcus, any of the bacteria enumerated above can take root in the prostatic portion of the canal, if only the soil is sufficiently harrowed to receive the seed.

Inasmuch as every passage of an instrument into the posterior urethra contuses that canal, at least to a slight degree, it is impossible to reproduce clinically the laboratory condition under which bacteria may be safely introduced into the bladder. *Ascending infection of the urinary tract, like descending infection, requires a contributory cause as well as a bacterium.* But clinically the contributory cause is ever present. No passage of a urethral instrument is entirely free from trauma. It is, therefore, the surgeon's first duty to see to it that his passage of urethral instruments be as cleanly as possible; his second duty, as important as the first, that the instrumentation be as gentle as possible.

But inasmuch as the normal anterior urethra cannot be made wholly

aseptic, while the bladder into which the urethral instrument passes, and the prostate over which it passes, are often already diseased and contain in themselves the contributory causes of infection and even (in the case of the chronically inflamed prostate) the bacteria themselves, it is obvious that no amount of cleanliness or of gentleness will protect the bladder against infection when instruments have repeatedly to be passed, as, for instance, in the treatment of prostatic retention.

2. Infection of the bladder by direct extension of urethritis occurs in gonorrhea, and in stricture; also possibly from the prostate in cases of prostatic retention. Direct extension of urethritis to the trigone is even commoner in women than in men.

3. Whether the bacteria of the uninflamed anterior urethra can ascend to the bladder against the urinary stream is not yet definitely determined.

Ascending Infection of the Kidney.—Innumerable experiments have repeatedly proven that bacteria do not ascend from the bladder to the kidney in animals unless there is some accessory cause of infection. This accessory cause, both in experiments and in the human being, is usually some form of retention of urine.

The routes by which infection may conceivably reach the kidney from the bladder are three:

1. Up the lumen of the ureter.

2. Through the lymphatics extending along the ureter from the bladder to the kidney pelvis.

3. By lymphatic absorption from the bladder or prostate into the general circulation, and thence, by what is actually a descending infection, into the kidney parenchyma.

Evidence has been accumulating for years to disprove the theory that infection can travel along the inside of the ureter from bladder to kidney. This evidence has been summed up and made final in the observations of Sweet and Stuart.[1] They have reviewed the evidence of the existence of a network of lymph vessels in the mucosa, and submucosa, as well as in the external coats of the bladder and ureters and in the pelvis of the kidney, and have shown that this network anastomoses freely throughout. In their experiments they have traced infection up these lymphatics, and have shown, by replacing a section of the ureter with a tube that maintains the lumen of the canal, but interrupts the lymphatic flow, that under appropriate circumstances bacteria will travel up to the opposite kidney whose lymphatics are intact, but not up to the kidney whose ureter has been divided; although the trauma of ureteral division should, in itself, lower the resistance of that ureter.

How frequently such lymphatic infections of the kidney occur re-

[1] *Surgery, Gynecology and Obstetrics*, April, 1914, xviii, 460.

mains an open question. The familiar acute, so-called ascending infection, such as is seen in postoperative infection, in prostatic retention infections, in urethral chill, and in defloration pyelitis, has been shown in several instances to be associated with a general bacteremia, while post mortem examination fails to show any evidence of ascending lymphatic infection along the ureter.

Crabtree cites a case in point: The patient entered the hospital for the treatment of a prostatic retention of urine. A catheter was tied in the urethra, and repeated cultures made from the urine obtained through this catheter failed to show any bacterial growth. On the seventh day the patient complained of some uneasiness in the perineum. A blood culture was promptly made, revealing colon bacillemia. Meanwhile the urine still remained sterile. Then the patient had a chill, fever, pain in the loin, and a sharp fall in the output of phenolsulphonephthalein. Blood culture was now negative, but culture of the urine showed bacillus coli. In due course the phenolsulphonephthalein output returned to normal, the patient submitted to perineal prostatectomy, and two weeks thereafter died of streptococcus septicemia. Post mortem examination revealed no gross evidence of renal infection, or of lymphatic infection about the kidney pelvis and ureter.

Such cases force us to the conclusion that the acute phenomena of kidney infection under the clinical circumstances enumerated above, although they have always been spoken of as ascending infections, are actually descending infections from a source in the lower urinary organs (or in the vagina in the case of defloration pyelitis).

Thus the absence of any positive evidence of spontaneous infection of the normal bladder from the normal urethra, or of the kidney from the bladder, leaves the theory of spontaneous ascending infection "from the short urethra" of women without support. If this does occur, we have no theory whereby it can be explained.

Direct Lymphatic Invasion.—The possibility of direct lymphatic infection up the ureter has been shown by Sweet and Stuart. The possibility of direct infection of the right kidney from its lymphatic communication with the hepatic flexure of the colon has been shown by Franke.[1] It is also possible that the bladder may be directly infected by lymphatic invasion from the rectum or the vagina. Finally, any portion of the urinary tract may be directly infected by lymphatic absorption from an adjacent focus of suppuration.

But the actual frequency of infection along any of these routes is by no means certain. Future investigators will have to determine their clinical importance.

Infection by Eruption and Trauma.—The mechanism by which infection reaches the urinary channels from the rupture of an abscess into

[1] *Grenzgeb. d. Med. u. Chir.*, 1911, xxii, 623.

them, or by trauma directly introducing bacteria, requires no special explanation. But it is not to be forgotten that if the urinary passages are otherwise normal even the discharge into them of pus from a suppurating appendix, an intestinal fistula or a pyosalpinx produces only a localized infection.

THE ACCESSORY CAUSES OF INFECTION OF THE URINARY ORGANS

The mere passage of pus and bacteria through a normal bladder discharging from an infected kidney does not cause cystitis. The mere presence of infection in the bladder, without retention of urine, does not cause infection of the kidney. The mere presence of bacteria in the blood does not cause infection of the kidney. Indeed, when the kidney becomes infected in the course of a pyemia, the characteristic result is the bilateral pyemic kidney, very different from anything we have to deal with in surgery. Such clinical observations require explanation.

The laboratory suggests the explanation. It has been shown again and again by various experimenters that the normal kidney and the normal bladder are not harmed by the injections into their cavities of enormous quantities of pathogenic bacteria; while intravenous injection of bacteria either causes the bilateral pyemic kidney or apparently does no harm. But if the urethra is tied off, both bladder and kidneys may be readily infected. If one ureter is tied off, or one kidney traumatized, injection of the bacteria into the circulating blood results in infection of that kidney. Manifestly, therefore, we may look for the cause of infection of the urinary organs in some accessory condition that renders the organ in question peculiarly liable to infection. Such a condition we speak of as the accessory cause of infection.

We should consider these accessory causes of infection in the light of recognized clinical conditions. Some of these clinical conditions are readily explained, e. g., infection due to retention, stone, or trauma. Some are not so easily explained, e. g., the pyelonephritis of little girls. Perhaps the best test of any general theory of the accessory cause of infection in obscure cases is that it should explain why the right kidney is more often acutely infected than the left, why the kidneys of women are more often infected than those of men, why women are so commonly infected in their infancy. In other words, the theory must explain the infection of the right kidney of little girls.

The accessory causes of renal infection include any condition, whether mechanical or toxic, that reduces the resistance of one or both kidneys to infection. They may be classified as follows:

1. Retention.
   a. Urethral.
   b. Ureteral.
2. Trauma.
3. Toxic influences.
4. Reflex influences.

Retention.—Retention of urine, whether acute or chronic, causes congestion of all that portion of the urinary tract lying above the point of retention. Thus if the retention is in the urethra, both kidneys and the bladder are involved. If it is in one ureter only, one kidney is involved. The congestion is due to actual pressure of urine. Anyone who has seen a patient writhing in the agonies of acute retention of urine will not doubt its existence in acute cases. The congestion of the kidneys in chronic retention is shown by the reduction in the output of solids, notably of phenolsulphonephthalein. It is also shown by an acute congestion at the time of relief of renal retention, signalized by a marked polyuria. Albarran was the first to note that the evacuation of an intermittent hydronephrosis was followed by a period of polyuria from that kidney. A similar polyuria is a feature of grave prostatic retention. But even the slightest obstruction is quite capable of disturbing the normal physiological condition of bladder and kidneys. Thus very slight obstructions at the bladder neck may cause retention of urine, stone formation, and sometimes undue irritability of the bladder. Similar slight and unsuspected obstructions of the ureter may cause congestions of the kidney, which, though they may be but slight or temporary, may happen at a time when the presence of bacteria in the blood offers the occasion for renal infection. Crabtree's case cited above is a very good example of how temporary even an acute infection of the kidneys may be.

If we are to find in the theory of retention a cause for the infection of the right kidneys of little girls, we must seek it in some congenital condition. Let it be understood that the following theory is but a theory. Although it seems at the present moment the most likely explanation of obscure infection of the kidney, it is no more than this. But until some better theory supersedes it, we may take the liberty of expounding it directly as though it were an established fact, since this simplifies the exposition.

Renal mobility is discussed in Chapter XLV. Therein will be found an exposition of the theory of Volkow and Delitzen, which pretends to explain by a study of the anatomical shape of the niche in which the kidney lies why this niche, being shallower in women than in men, and on the right side rather than on the left, makes the right kidneys of women more liable to mobility (as, indeed, we clinically know they are) than their left kidneys or than either kidney of a man. It is

to be noted further that in many instances the position of the body determines whether the kidney shall be mobile or not, and that children may be trained to hold themselves in such a way that their kidneys shall not become mobile when they reach adult life. Thus, although what might be termed the gross mobility of the kidney occurs in adolescence and thereafter, the beginnings of this mobility are congenital.

Now it is well known that the grossly mobile kidney encourages inflammation, and does so by virtue of kinking of the ureter whereby a moderate or temporary retention occurs in the kidney which may, under exceptional instances, reach an intensity shown by the complete retention of Dietl's crisis or of intermittent hydronephrosis.

The same conditions exist to a lesser degree in little children. But it is to be remembered that little children are much more subject to infections of all sorts than adults. Their immunities are undeveloped by contact with infection. Doubtless their kidneys share this lack of immunity, and doubtless, therefore, the kidneys of infants are more readily infected than those of adults. This combination of unusual susceptibility to infection, and tendency to mobility, explains, we believe, the infection of the kidney in children, and more particularly the infection of the right kidney in little girls.

The only other theory that has been seriously advanced to explain this condition is that the vagina of little girls is often infected with colon bacilli from the rectum, that the urethra of little girls is short, that they often have incontinence of urine, and that under these conditions the bacillus coli readily invades the bladder, and then the kidneys. But all our experimental evidence points to the fact that no infection can result from the invasion, either of the bladder or of the kidneys, by colon bacilli or by any other pathogenic bacteria, unless there are accessory causes of infection at work. Renal mobility is the most plausible accessory cause. Whether in the presence of renal mobility, a short urethra, or an infected vagina, or incontinence of urine helps to infect the kidney we do not know. It seems rather more probable that the infection is usually derived from an inflamed colon.

A third theory of infection which would infect the right kidney directly from the lymphatic connection with the hepatic flexure of the colon would be difficult either to prove or to disprove. But since it does not explain the frequency of this condition in little girls, we may neglect it.

Most acute infections can be considered in terms of retention. Even stone and tumor often excite infection not less as foreign bodies that obstruct the outflow of urine than they do as a breeding ground for bacteria, or a source of surface irritation.

Ureteral obstruction is usually unilateral. It may be due to obstruction within the ureter (e. g., stone, tumor, blood clot, stricture),

to angulation of the ureter (e. g., nephroptosis, or traction by tumors within the pelvis), or to pressure from without (e. g., by the pregnant uterus, by carcinoma, by appendical or other abscesses, etc.).

Urethral retention causes infection of bladder and both kidneys. The infection may, however, be mild in one kidney, acute in the other. The acute infection may have for its accessory cause only the urethral retention. But there may arise a secondary ureteral cause of retention, such as a kink. In order to relieve such renal retention it is necessary to relieve not only the urethral but also the ureteral obstruction.

The one flaw in this mechanical theory of renal infection is the infection of the opposite kidney. Not only is pyelonephritis almost always bilateral, but acute infection of one kidney is almost always associated with mild infection of its fellow. This mild infection of the opposite kidney is doubtless due to toxic rather than to retentative causes, as described below.

Trauma.—Trauma includes not only the open wound and the obvious contusion, but also the trauma of stone, the trauma of slight wrenches and unnoted bruises, and, above all, the trauma of urethral instrumentation which is so large a cause of infection.

Toxic Influences.—We may note in passing that certain renal toxemias do not appear to predispose the kidney to bacterial infection. Bright's disease, whether acute or chronic, does not appear to make the kidney a good soil for bacterial growth. Tuberculosis of one kidney often produces a toxic nephritis in its fellow, and not infrequently this intoxicated kidney is mildly infected with bacillus coli or the pyogenic cocci. But I have never seen a grave infection under these circumstances.

But, as suggested in the preceding section, retention is not by any means the whole story in the accessory causation of renal infection. Thus in certain instances it is quite obvious that the hyperacute renal infections of infants are due to abscesses or infections elsewhere in the body producing a grave toxemia. The frequency of mild renal infection in the course of typhoid fever, and the readiness with which this infection gets well, both show that the intensity of the toxemia has much to do with causing the renal congestion that causes kidney infection. The preponderance of bilateral bacillus coli infection tells the same tale. Yet if we accept the doubtful case of children these toxic influences may be blamed rather for mild, chronic bilateral infections than for the more acute ones which require treatment. Indeed, it is an open question whether acute attacks of renal infection are not like acute attacks of Bright's disease, mere incidents in the course of a chronic, perhaps unsuspected, infection. Be that as it may, acute infection is apparently due rather to mechanical causes, chronic infection often to toxic ones.

Reflex Influences.—Mild infection of a kidney opposite to an acutely infected kidney might be set down to reflex influences in the sense that that opposite kidney is called upon to do extra work through the disease of its fellow, and to become obviously congested and enlarged if its fellow is chronically debilitated as well as acutely diseased.

The prostatorenal reflex is, however, of far more importance. Urethral chill, though it follow the passage of instruments into the urethra, is actually the expression of an acute infection of the kidney. Between the time of the passage of the instrument and that of the occurrence of the chill, a general bacteriemia develops. Urethral chill probably never occurs unless the kidney has been previously damaged by chronic infection or by retention.

We may once again cite Crabtree's classical case as tracing the course of the bacteria from the blood through the inflamed kidneys into the urine.

Defloration pyelitis is doubtless only a form of urethral chill. There is good reason to believe that many women, who have had acutely infected kidneys in their infancy, continue to harbor a latent colon bacillus infection in the pelvis of the kidney, and that this is the occasion of the acute outbreak at the time of the rupture and infection of the hymen.

SUMMARY

Apart from the tubercle bacillus, the important infecting microorganisms of the urinary tract may be divided into two groups. On the one hand, the colon group causing 90 per cent of the infections of the pelvis of the kidney. On the other hand, the pyogenic cocci which predominate in perinephritic abscess and divide with the colon group the etiology of infections of the bladder.

Mixed infections are common.

The commonest mode of infection is by an initial inflammation of the kidney parenchyma through bacteria derived from the blood stream.

Ascending infection from the bladder to the kidney does not ascend as a surface infection along the ureter. It may occur along the lymphatics of the ureter. It probably occurs with great frequency by absorption from the prostate or bladder into the general circulation, and re-excretion of bacteria through the kidney. It is, therefore, actually a descending infection.

The presence of bacteria in the circulating blood does not entail a renal infection.

Bilateral renal infection is doubtless often due to a toxic accessory

cause. Unilateral infection is usually due to a mechanical accessory cause, and this is most frequently some form of retention.

The accessory causes, more than any other factor, determine the acuteness of the infection and its pathological development.

CHAPTER XXXIV

PATHOLOGY OF RENAL INFECTION

The phenomena of renal infection are due to a common bacterial cause. But clinically they present the widest variety, both in intensity and in duration. No contrast could be greater than that between microscopic bacteriuria and a hyperacute focal suppurative nephritis. Yet the one may, under appropriate circumstances, be transformed into the other.[1]

We are obliged to consider the lesions of pelvis and parenchyma separately. Indeed, in the preceding chapter we have spoken of infection reaching the kidney parenchyma first and then the pelvis. Yet clinically speaking inflammation of the pelvis of the kidney means inflammation of its ureter, and of the kidney parenchyma as well; while inflammation of the kidney parenchyma without some inflammation of the kidney pelvis is the rarest of exceptions. Thus the lesions described below form only the various parts and phases of a single picture of what we know as renal infection.

The lesions of renal infection may be classified as follows:

1. Acute suppuration of the kidney.
    a. The pyemic kidney.
    b. Focal suppurative nephritis.
2. Acute pyelitis.
3. Chronic pyelonephritis.
4. Pyonephrosis.
5. Infected hydronephrosis.
6. Perinephritis.
    a. Fibrolipomatous.
    b. Suppurative.
7. Rare inflammatory conditions of the renal pelvis.
    a. Pyelitis granulosa.
    b. Malakoplakia.
    c. Pyelitis cystica.
    d. Leukoplakia.
    e. Incrustation.

[1] Recent observations by Crabtree (Cabot, *Trans. Am. Assn. G.-U. Surg.*, 1916) tend to dissociate more clearly than ever before the acute lesions of the renal parenchyma (due to pyogenic cocci) from those of the pelvis (due to bacillus coli).

ACUTE SUPPURATION OF THE KIDNEY

The Pyemic Kidney.—By the pyemic kidney we understand a condition of multiple suppurating points in both kidneys. The abscesses are chiefly in the cortex. The renal lesion is only part of a general pyemia. Consequently the patient dies before the lesions are far advanced or have ruptured into the perinephritic space or into the kidney

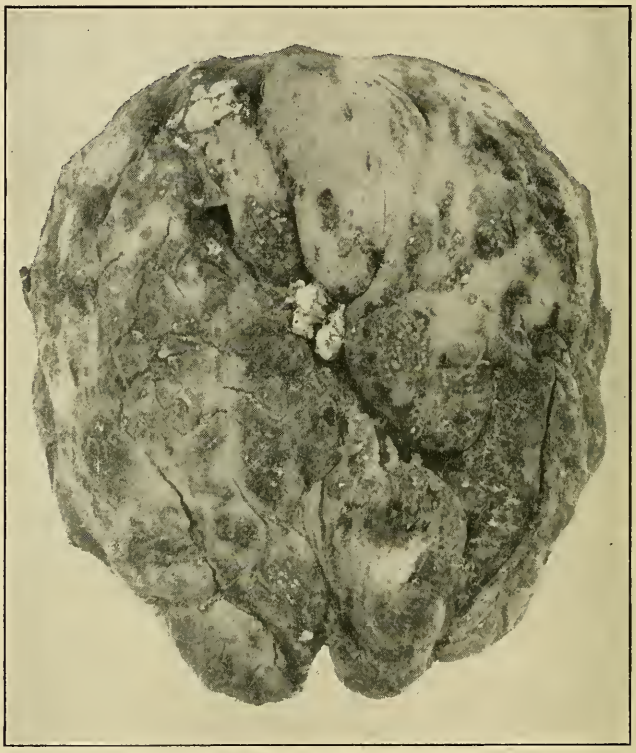


FIG. 67.—FOCAL SUPPURATIVE NEPHRITIS. The kidney is split and seen from without. It is mottled by groups of miliary abscesses. Vessels and ureter in center.

pelvis. The lesions manifest themselves only by interference with the kidney function; the diagnosis is made post mortem; the condition has no clinical interest.

Focal Suppurative Nephritis.—The acute bacterial infections of the kidney, though they vary in importance from a brief urethral chill to the rapidly fatal condition which Brewer has made familiar under the name of unilateral septic infarcts of the kidney[1] may all be grouped under the title "Focal Suppurative Nephritis."

The milder lesions consist of little more than an acute degeneration

[1] *Surg. Gyn. and Obst.*, May, 1906; *J. A. M. A.*, July 15, 1911.

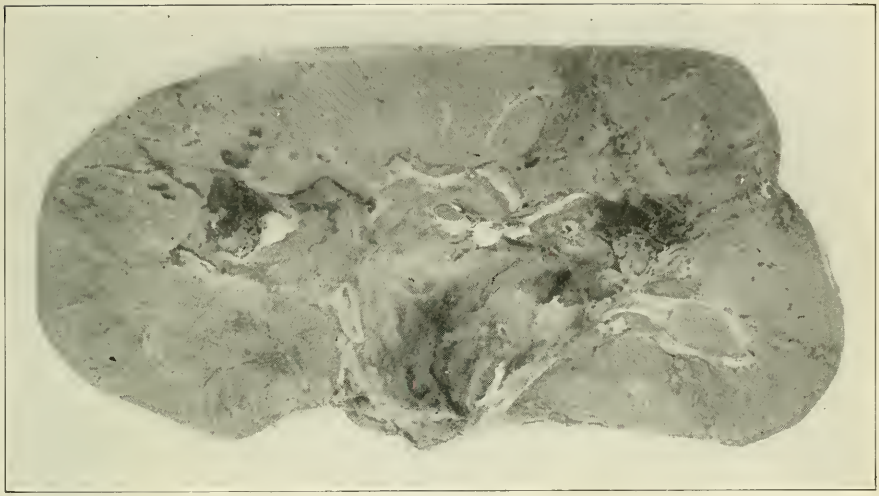


FIG. 1

FIG. 2

FOCAL SUPPURATIVE NEPHRITIS.

FIG. 1.—ACUTE STAGE. The pelvis is congested and ecchymotic. There are streaks of pus showing the lines of lymphatic absorption. Also a large "infarct."

FIG. 2.—NEGLECTED CASE. The kidney is a multilocular abscess.

and congestion of the whole kidney parenchyma. With this or any of the more acute lesions there may be associated an acute pyelitis.

A more intense degree of inflammation of the kidney parenchyma shows itself in the production of areas of localized necrosis and suppuration in various portions of the cortex and pyramids. If the infection is due to colon bacillus these lesions are chiefly in the medulla, near the pelvis. But from these initial foci of suppuration lymphatic absorption takes place radiating through the parenchyma of the kidney toward the capsule, with the formation of secondary areas of necrosis and suppuration here and there in the course of this lymphatic absorption. Thus are formed the characteristic wedge-shaped lesions of acute suppuration and degeneration so characteristic of focal suppurative nephritis, to which the name septic infarcts is given. This title is a misleading one. The lesions in many instances are perfectly well known not to be infarcts. Thus, for example, they frequently occur in a chronically inflamed kidney after the removal of a stone from the pelvis. In such a case there can be no question of actual infarcts. With these colon bacillus lesions of the parenchyma there is always associated a pyelitis, acute or chronic (Fig. 67; Pl. XI).

If still further neglected these suppurating points may resolve or may discharge into the kidney pelvis (in which case the patient may spontaneously recover) or into the perinephritic tissue (in which case operation is usually necessary to a cure). In other cases the suppuration continues within the kidney parenchyma until finally the patient dies of septicemia or pyemia.

The more acute cases that come to operation show a large congested kidney with multiple small abscesses under the capsule, or perinephritic abscess, or simply irregularly distributed patches distinctly projecting beneath the capsule, and darker in color than the surrounding parenchyma. On section these irregular areas are found to be the bases of the pyramidal patches of lymphatic absorption from medullary abscesses.

ACUTE PYELITIS

I have seen but two instances of this lesion: One not due to retention showed a generally swollen bright red interior to the kidney pelvis. The other, due to ureteral stone, showed a blotchy petechial condition, microscopic examination of which revealed acute inflammation and degeneration.

A more intense form of pyelitis is sometimes seen as the result of acute obstruction of the ureter by stone. In such cases the combination of intense distention with acute infection causes gangrene of the ureter, comparable to that so commonly seen in virulent infections of

the appendix. Curiously enough the kidney above such a ureter and kidney pelvis may show only an acute congestion.

CHRONIC PYELONEPHRITIS

The mildest type of chronic renal infection, *renal bacteriuria,* produces lesions so slight that they have not been precisely identified. Crabtree believes the foci of chronic infection lie just beneath the mucosa of the pelvis of the kidney, about the calices.

More severe cases of long duration exhibit a kidney adherent in more or less fibrolipomatous perinephritis. The organ itself may be not far from normal in size, but the pelvis and ureter are likely to be thickened, dilated, and also surrounded by adherent sclerotic fat. This moderate dilatation of the kidney pelvis and ureter occurs independently of any recognizable ureteral obstruction.[1] On section the kidney markings are lost, its tissue rather pale and fibrous in character, the cortex thin, the papillae flattened in the dilated calyces. The surface of the pelvis and ureter may show a glazed or granulating appearance or may manifest any of the unusual changes to be later described.

The microscope reveals destruction of the kidney parenchyma by sclerosis, pyogenic infiltration, and degeneration. Similar microscopic lesions are found in the kidney pelvis and ureter.

The ultimate outcome of this chronic sclerosis is to leave the kidney little more than a pyonephrotic shell.

Stone is a common cause and complication of pyelonephritis.

PYONEPHROSIS

Pyonephrosis is a term somewhat loosely applied to cover two differing conditions.

One of these is the relatively acute condition developing as the result of retention combined with infection. The retention causes dilatation of the kidney; the infection, while not sufficiently acute to cause any very marked acute renal parenchymatous changes, usually produces a relatively thick pus within the kidney pelvis, and a relatively rapid sclerosis of the kidney parenchyma. If such a case is operated upon early, the kidney is found imbedded in a thick edematous mass of perirenal fibrolipoma. The organ itself is much distended. The ureter as a result of dilatation, thickening of its walls, and perirenal adhesive inflammation, may be as big round as the finger. On section thick pus flows from the dilated renal pelvis, the renal

[1] Pyelography often gives a picture quite like that shown in Fig. 82.

parenchyma shows marked lesions of chronic pyelonephritis, perhaps interspersed with foci of acute infection.

The other, or chronic type of pyonephrosis, is the result either of a mild infection in a dilated kidney or simply the end phase of severe chronic pyelonephritis. In such cases, though the renal pelvis be considerably dilated, the parenchyma is so much shrunken that the total mass of kidney may be actually smaller than the normal; usually, however, it is much larger than normal, and may attain enormous size. The dilated pelvis is often only a scar in which it is impossible to distinguish where pelvis ends and kidney begins. The fibrolipomatous perinephritis assumes enormous proportions, so that the kidney lies embedded in a dense fatty capsule which may be several centimeters thick. Indeed, on section it may be found that the very renal parenchyma itself has been replaced by fat, so that in the most extreme cases of this type the kidney pelvis is capped, not by renal parenchyma, but by its semblance in lobules of dense yellow fat.

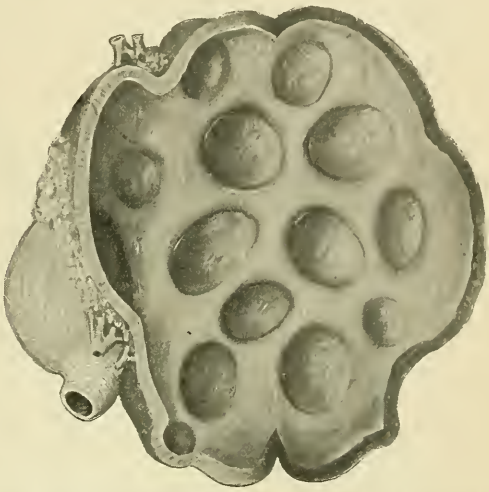


FIG. 68.—PYONEPHROSIS. The kidney is reduced to a multilocular suppurating cavity.

INFECTED HYDRONEPHROSIS

The infective lesions are those of pyelonephritis, the essential lesion that of hydronephrosis (p. 458).

PERINEPHRITIS

Fibrolipomatous Perinephritis.—Fibrolipomatous perinephritis is the aseptic reaction of the perinephritis tissue to the lymphatic distribution of toxins from bacterial processes within the kidney. The earliest reaction found upon operation upon acute cases of renal infection is edema of the fibrofatty envelope. As the process becomes chronic, this edema is replaced by scar, binding the perirenal tissues to the fibrous capsule of the kidney, and enveloping masses of dense

yellow fat, very different from the normal soft, white perirenal fat. This protective perinephritic reaction has little clinical interest, excepting insomuch as it markedly increases the difficulties in nephrectomy for old renal infection. In ancient cases it envelopes in a thick mass the kidney, the pelvis, the ureter, and the pedicle, and in some instances it even replaces the kidney tissue itself, so that the line of demarcation between kidney and perirenal fibrolipoma is but a thin line of scar, which is all that remains of the kidney capsule.

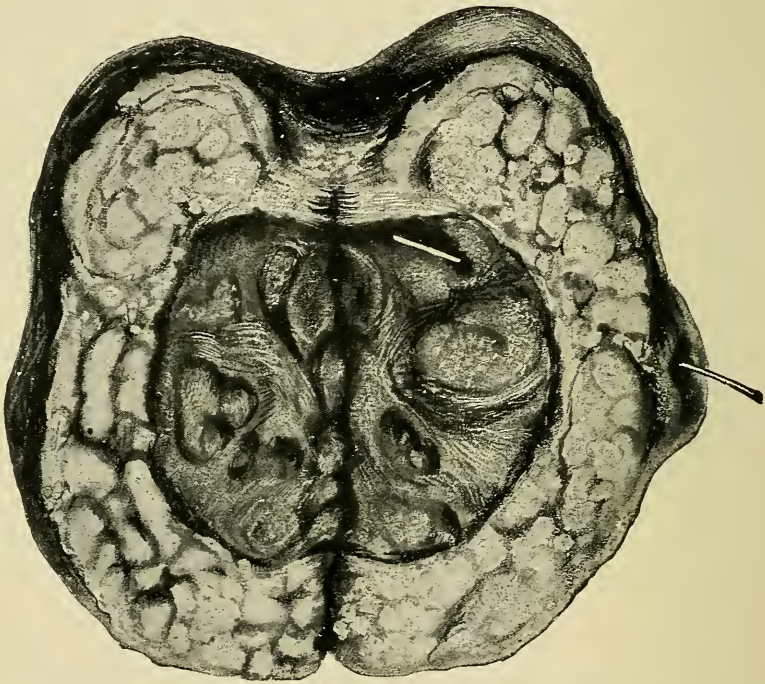


Fig. 69.—Perinephritis (Morris). Dense fibrolipomatous perinephritis due to intrarenal suppuration. The probe shows a fistula, through which the suppuration has extended to the perirenal tissue in spite of the protective inflammation.

Suppurative Perinephritis.—Although clinically the distinction cannot always be made, we must recognize the pathological difference between true perinephritic abscess, i. e., suppuration within the fascial capsule of the kidney, and false perinephritic abscess occupying the retroperitoneal fat, but originating outside of the perinephritic fascia, and more properly termed subdiaphragmatic or paranephritic abscess. True perinephritic abscess probably always arises from some lesion of the kidney cortex; though in many instances this lesion is not discovered. False perinephritic, or subdiaphragmatic, abscess is due to suppuration in the surrounding viscera or parietes.

As already stated, the pyogenic cocci predominate in the pus.

Thus Miller[1] found staphylococci in twelve cases, streptococci in two, streptococci and pneumococci in one, bacillus coli in six (two were sterile). Not counting the sterile cases, this series shows 71 per cent of pyogenic cocci as against 24 per cent bacillus coli; quite the reverse to the statistics for pyelonephritis.

The perirenal fascial envelope usually permits the suppuration within it to extend only through its open lower end. Thence it passes forward over the ileum, and even into the true pelvis. If neglected it may burst into the intestine, or the bladder, or through the skin, or it may even pass upward through the fascial envelope and rupture into the pleura or lung.

RARE INFLAMMATORY CONDITIONS OF THE RENAL PELVIS

The following conditions may all occur in the pelvis, the ureter, or the urinary bladder, though they are likely to be chiefly, or even exclusively, confined to one or the other extremity of the urinary reservoir. All of them are rare; all of them appear to have some relation to chronic bacterial infection and inflammation of the pelvis and bladder.

Pyelitis Granulosa.[2]—Pyelitis granulosa or follicularis is a lymphoid infiltration of the mucous membrane of the kidney pelvis. It is apparently the result of chronic pyelitis, though it is said to have been found post mortem in uninfected cases. The pelvis presents a rough and pebbled gross appearance. The microscope reveals little aggregations of lymphoid tissue in the mucosa. They are vascular, and show a tendency to capsule formation. The larger ones may ulcerate. They usually produce no symptoms. They may bleed or deliver pus.

Malakoplakia.[3]—This consists in grayish or yellowish nodules made up of large cells (20μ in diameter), containing colon bacilli, leukocytes and peculiar cell inclusions. These nodules may be found in the renal parenchyma as well as on the mucous membrane of the urinary reservoir.

Pyelitis Cystica.—This condition, like the preceding two, is usually associated with chronic inflammation. It is commoner in the bladder than in the pelvis of the kidney. The lesions are usually multiple, and vary from small red elevations on the mucous membrane that look precisely like pyelitis granulosa, to larger bodies that when seen through the cystoscope in the bladder, for instance, or observed in the kidney pelvis post mortem, look distinctly cystic. The cysts apparently never

[1] *Annals of Surg.*, March, 1910.

[2] Kretschmer, *Surg., Gyn. & Obstet.*, 1913, xvii, 612.

[3] MacDonald and Sewell, *Jour. Path. & Bact.*, 1914, xviii, 306.

attain a very great size. Under the microscope the lesion looks very much like a papilloma, with the difference that the true neoplasm springs from the surface of the mucous membrane, and projects above it, while cystitis cystica is, as it were, inverted, and digs under the epithelial surface of the mucosa. The larger lesions are frankly cystic (Figs. 68 and 108).

Leukoplakia.[1]—Leukoplakia occurs much more rarely in the bladder than on the tongue, much more rarely in the kidney pelvis than in the bladder. No relation has been established between urinary leukoplakia and syphilis. Published reports do not suggest any tendency to malignancy, although leukoplakia of the urethra is a distinctly malignant condition. I have seen two cases of leukoplakia in the bladder, the lesions occupying the fundus, and the regions back of the ureter mouth. I have never seen leukoplakia of the kidney pelvis. The bladder lesions resemble those seen upon the tongue, a whitish, thick, epithelial, flat surface with a reddish border, while here and there in the vicinity are seen reddish lesions of chronic inflammation upon which the squamous epithelium has not yet collected in sufficient quantities to give them the white color.

Calculous Incrustations.[2]—Phosphatic incrustation upon an ulcerative inflammatory lesion is always due to ammoniogenic bacteria, usually the pyogenic cocci or the proteus. Phosphatic incrustations are also seen on the renal lesions of tuberculosis. Indeed, this is the commonest form of incrustation in the kidney pelvis. Bladder incrustation is usually the result of the infection following upon the establishment of a permanent suprapubic fistula, but it also occurs in connection with phosphatic stone, tumor and even in cases of chronic pyelitis and cystitis. Incrustation and ulcer alike are the expressions of the reaction of the mucosa to a virulent ammoniogenic inflammation.

[1] Beer, *Am. Jour. Med. Sci.*, 1914, cxlvii, 244. Lecène, *Jour. d'Urol.*, 1913, iii, 129.

[2] Caulk., *Trans. Am. Assn. G.-U. Surg.*, 1914.

CHAPTER XXXV

THE CLINICAL PICTURE OF RENAL INFECTION

Infection of the kidney often first shows itself by an acute febrile attack. This may be so mild as to escape diagnosis or so severe as to prove fatal within a few days. Usually it subsides in time, however, leaving the patient with chronic pyelonephritis. This in turn may be so mild as to be to all intents and purposes harmless, or if complicated by retention, stone, trauma, etc., its course may be interrupted by outbreaks of acute infection, and it terminates in pyonephrosis.

Certain of the lesions described in the preceding chapter do not interest us as clinicians. Thus the pyemic kidney kills without symptoms worthy of the name, and the various rare lesions of the renal pelvis are rather pathological curiosities than clinical entities.

ACUTE RENAL INFECTION

Under this title we may group the lesions variously described as acute pyelitis, acute pyelonephritis, focal suppurative nephritis, unilateral septic infarcts, etc., for these are but milder or severer examples of a single pathological process.

The one common symptom of all these conditions is *fever*. The cases may be classified as mild, severe, and fulminating.

Mild Cases.—The only subjective symptom is a rise of temperature. If the renal infection is due to the pyogenic cocci, and occurs in the course of a sepsis, no pus may appear in the urine, and the renal involvement may evade diagnosis unless it leads to perinephritic abscess. Such infections may be diagnosed with a reasonable degree of certainty by loin tenderness combined with the finding of pyogenic cocci in the urine obtained by ureter catheter from the kidney, and also by the lowering of the phenolsulphonephthalein and urea output.[1] Mild infection of the colon or pyelitic type may be due to coccus infection.

Mild renal infection due to colon bacillus is much more common.

[1] I saw Dr. Beer operate upon a small staphylococcus perinephritic abscess due to a single focus of renal infection. Yet the urine from this kidney had shown no diminution of function, no pus, no bacteria by culture.

It is characterized by fever of an irregular type, and the appearance of pus and colon bacilli in the urine. The phenolsulphonephthalein and urea output are lowered. There may or may not be pain and tenderness in the loins. In certain cases the clinical picture is dominated by frequent and painful urination. This symptom is purely reflex, and does not indicate the presence of inflammation of the bladder (p. 343).

In other cases digestive symptoms predominate. This type of case is especially misleading in infancy when a clean specimen of urine is so hard to obtain. But a study of the urine for pus and bacteria, and impairment of the renal function establishes the diagnosis.

The course of these cases is most irregular. They may drag along quite indefinitely, or through the intervention of some accessory cause they may at any time become more severe. Under appropriate treatment they usually subside into chronic pyelonephritis.

Severe Cases.—Severe acute renal infection is but an intensification of the mild acute infection described in the preceding paragraphs. The attack usually begins with a chill, and proceeds with an irregular septic temperature, leukocytosis, impairment of renal function, and pus, albumin and bacteria in the urine.

The dominating feature of the clinical picture (apart from the fever) is pain and tenderness in the loin. The pain is usually so severe that the patient complains of it, the tenderness in the kidney may be elicited by ballottement, even when the kidney itself is impalpable. As a rule, however, the kidney is palpably enlarged, as well as sensitive.

Tenderness of the kidney means tension upon its capsule. Apart from such obvious causes of tension as trauma, acute retention, etc., renal tenderness is almost pathognomonic of infection. Compensatory hypertrophy constitutes the one misleading exception. Since compensatory hypertrophy is often due to inflammatory destruction of the opposite kidney the exception is manifestly an important one.

Fulminating Cases.—In the most severe cases, however, the intense sepsis overshadows all other symptoms. The kidney is exquisitely sensitive to pressure, but the pain is felt rather as a general sensitiveness of the upper abdomen than as a pain in the loin. Such truly fulminating attacks are likely to be mistaken for some form of peritoneal sepsis (due to appendicitis or cholecystitis). They are readily differentiated by the exquisite kidney tenderness. The fulminating case is often due to staphylococcus. The ureter catheter specimen may show only red blood cells and bacteria as evidence of disease.

Immediate nephrectomy is required to save the patient's life.

CHRONIC PYELONEPHRITIS

Chronic pyelonephritis usually begins with an acute febrile attack, though this may be so mild as to be overlooked. It continues under one of three types:

1. Bacteriuria or pyuria without symptoms.
2. Painful symptoms, with pyuria.
3. Toxic and septic symptoms, with pyuria.

These clinical types are not mutually exclusive. Indeed, many patients during the greater part of the course of their disease suffer no subjective symptoms at all, and may be classed under the first type. But from time to time they not only develop painful symptoms or septic or toxic symptoms, but also may suffer intercurrent attacks of acute infection. The more acute attacks are likely to occur in one kidney, yet not only is it almost the universal rule that both kidneys are infected, but it is also quite usual that the diminution of function is almost as marked in the silent kidney as it is in the painful or tender kidney. Such cases are manifestly poor subjects for nephrectomy.

Stone, either primary (the cause of infection) or secondary (the result of infection), is a very common complication of chronic pyelonephritis.

The prognosis of these chronic renal infections is bad. The milder types are indeed curable, and even if not cured may continue for many years without gravely impairing the patient's health. So long as the kidney drainage is good, the patient may scarcely call himself sick, although he may have had an active chronic pyelonephritis for many years. Complicating stone, even though this grow to an enormous size, and thereby hasten the destruction of kidney parenchyma, does not portend an immediate fatal issue unless the stone obstructs the ureter, a thing which it is likely ultimately to do. But I have known several cases to continue in very good health for thirty or forty years, even with stone (Pl. VI).

The ultimate outcome of chronic renal infection is, however, the total destruction of the kidney parenchyma by chronic inflammation. If retention predominates over infection, the result is infected hydronephrosis. If, as is more commonly the case, infection predominates over retention, the result is pyonephrosis.

BACTERIURIA

Bacteriuria [1] is a clinical rather than a pathological condition. The bacteriuria is spoken of as partial when the bacteria are derived from

[1] Ten Broeck, *Surg., Gyn. and Obst.*, 1916, xxii, 349.

the prostate and the urine from the kidneys is uninfected. Bacteriuria is total when caused by a lesion in the kidney pelvis.

The bacteria may be so few as not to produce any pus, not to cloud the urine, and not to be discernible even by smear. Only culture reveals them. Such a condition may exist quite unsuspected for many years. Indeed, the majority of acute renal infections in young children, though they apparently terminate and leave the patient in perfect health with no visible pus, bacteria or albumin in the urine, actually continue in this occult type of bacteriuria. Let such a patient be subjected to one of the accessory causes of infection and acute renal infection promptly occurs.

Ross,[1] for example, made a bacteriological study of 106 children's urines. He found 43 cases of bacillus coli infection. Among these only 3 had a frank pyuria, 12 had a pure bacteriuria without pus, and 6 revealed bacilli only to culture. Among 19 supposedly normal cases, 8 were contaminated with staphylococcus albus.

The condition commonly spoken of as bacteriuria, however, is that in which the urine is swarming and clouded with bacteria, but contains no more than a few pus cells. Like the condition just described, it is actually a form of mild pyelonephritis, and if the case is closely watched for a considerable time, and repeated urinalyses made, pus will be found in the urine from time to time. Indeed, a transitory bacteriuria may be noted at the onset and close of many acute attacks of renal infection.

The bacteria of bacteriuria are those of renal infection. Thus Suter [2] collected 169 cases showing bacillus coli, 13 showing staphylococci, 9 showing streptococci, and 6 showing other bacteria.

Bacteriuria is usually symptomless. But it may cause any of the symptoms of pyelonephritis.

PYURIA

Pyuria without symptoms is but evidence of an infection somewhat more grave, and definitely more progressive than that which causes simple bacteriuria.

Urinalysis of the urine obtained from a case of total or renal bacteriuria usually shows a trace of albumin and sometimes a few casts and epithelial cells from the kidney pelvis. But all of these may be absent. When the inflammation is severe enough to cause pyuria, however, there is always a trace of albumin in the urine, usually some cells from the kidney pelvis, rarely casts.

The absence of casts, so characteristic of all forms of surgical infections of the kidney, and so strikingly different from the conditions in

[1] *Lancet,* 1915, clxxxviii, 654.

[2] *Trans. III. Internat. Urological Assn.,* 1914.

medical nephritis, merits attention. A long and careful search of several specimens of urine will indeed usually be rewarded by the finding of a few casts, even in surgical cases. But these casts when found are more likely to be hyaline or granular than pus casts. Therefore it seems probable that they are due rather to an associated toxic nephritis than to the actual bacterial processes in the kidney parenchyma. Be this as it may, *the characteristic urine of renal infection does not contain casts.*

PAINFUL SYMPTOMS

The characteristic pain of *acute* renal infection or of pyonephrosis is felt in the loin, associated with tenderness of the enlarged kidney, and obviously due to tension upon the renal capsule.

Such pain in the loin may exist with chronic pyelonephritis; but this is unusual. The pain may be felt rather in front than behind and may be referred to the gall-bladder or appendix region, or to corresponding points on the left side.

The characteristic pain of *chronic* infection of the kidney is *frequent and painful urination.* This frequent urination is apparently due to the inflammation of the kidney pelvis and ureter. The cystoscope shows that it is not associated with inflammation of the bladder, yet the symptom of frequent and painful urination, whether due to simple pyelonephritis, stone in the ureter, tuberculosis of the pelvis of the kidney, or to cystitis, has no distinguishing characteristic. The cause of the frequent and painful urination can be diagnosed only by the cystoscope. This frequency is more commonly associated with calculous or tuberculous pyelonephritis than it is with the type of which we are now speaking.

TOXIC SYMPTOMS

Toxic symptoms in the adult are rather a measure of renal retention than of renal infection, but children with chronic renal infection often exhibit one or the other of the types of toxic symptoms although they apparently have no gross retention of urine in the kidney pelvis or bladder. The toxemia of renal infection shows itself in five types:

Digestive symptoms.
Cerebral symptoms.
Hiccough.
Rheumatism.
(High blood pressure.)

Digestive Symptoms.—The digestive symptoms of renal insufficiency if mild may be due either to infection or to retention. If severe they are commonly considered evidence of renal retention.

Superficially these digestive symptoms resemble those of so-called

chronic indigestion. The bowels are likely to be constipated, the patient thin, sallow and anemic, the appetite fanciful, and the patient usually complains of various abdominal discomforts, lassitude and loss of weight. But the striking feature of this toxemia is what the French call *"buccal dysphagia";* subjective if the toxemia is mild, objective if it is severe. In mild cases this amounts to little more than a dryness and stickiness about the tongue and the pharynx which the patient may vainly endeavor to control by drinking large quantities of water.

In the severe cases, the tongue not only feels dry, but is visibly dry, parched, red, pointed, and may even be cracked and fissured. The condition of the tongue is one of the most dependable physical signs in the prognosis of urinary infection. As the renal function is more and more impaired, the tongue and pharynx grow dryer and dryer; while if improvement occurs, the moistening of the tongue is often one of the first signs of this (Pl. XII).

When the tongue is moderately dry the patient actually cannot eat dry solid food. If the tongue is excessively dry, he cannot even swallow fluids.

Cerebral Symptoms.—Cerebral symptoms, arising from renal infection, belong rather to pyonephrosis than to pyelonephritis. Yet the very rarity and obscurity of such symptoms when arising without an evident septic cause is enough to make them remarkable in this connection. Cerebral symptoms indicate grave inhibition of the renal function.

The cerebral symptoms, if mild, consist of little more than an undue irascibility and inability to sleep, with some tendency to headache. If more severe, the patient becomes flighty at night, but is likely to be quite rational during the day. Rarely there may be attacks of excitement approaching the maniacal. The most severe symptoms are seen only in connection with the digestive symptoms, and the characteristic dry tongue. The patient is quite incoherent, and usually rather inclined to be dull, stuporous and comatose than excitable.

Hiccough.—Persistent hiccough, like the dry tongue and the cerebral symptoms, is an ominous sign of grave impairment of the renal function. Such being the case, we may remark parenthetically, that it is quite futile to attempt to treat persistent hiccough by any remedy excepting those designed to eliminate the poisons that the kidney cannot transmit.

Rheumatism.—Although toxic pains in various parts of the body form part of the picture of any grave toxemia, rheumatism of any importance is not usually due to toxemia of renal origin.

High Blood Pressure.—High blood pressure is a characteristic sign of the toxemia of non-bacterial nephritis. This may well be associated

THE TONGUE OF URINARY SEPTICEMIA.

The tongue is parched, scarlet, narrow, and pointed. It is often covered with a thick coat, and may be cracked, as shown in plate.

with bacterial nephritis, but the toxemia of the latter does not cause elevation of the blood pressure.

SEPTIC SYMPTOMS

The septic type of renal infection, urinary septicemia or urosepsis (by which name it is more familiarly called), is an infection characterized by an irregular temperature which, when severe, is likely to be associated with chills and a fever curve of the picket-fence type, usually accompanied by some of the toxic symptoms above described, notably the buccal dysphagia, and which, like any other sepsis, depends for its intensity, its gravity and its continuance upon the virulence of the infective microörganism, and the physical condition under which it is acting.

Urinary septicemia has no distinguishing characteristics, excepting its tendency to produce a buccal dysphagia and the fact that it is associated with impairment of the renal function, and pus and bacteria and albumin in the urine.

Urethral Chill.—Urethral chill is the only form of urinary septicemia that requires special mention. Urethral chill is a very acute infection following instrumentation of the posterior urethra. In its most characteristic form it consists of a chill, and a very sharp rise of temperature (even to 106° F.) following immediately upon the first urination after the passage of a urethral instrument. Within a few hours the temperature falls to normal. This may be followed by a few slight variations of temperature before the attack is concluded in the course of 24 to 48 hours. But it may be only the first of a number of chills, and may thus prelude a chronic septicemia.

The occasion of urethral chill is so manifestly the passage of an instrument through the prostatic urethra that it used to be considered of purely urethral origin, and much has been written to endeavor to explain the combination of shock and sepsis which should cause so violent a reaction. But careful observation of the patient both before, during and after urethral chill will disclose the fact that three elements are necessary and one usual to its occurrence. The three necessary elements are: chronic prostatitis, some form of impairment of the renal function, usually chronic pyelonephritis or pyonephrosis, and the passage of a urethral instrument. The usual element which combines all three of these cases is retention due to stricture or prostatism, requiring catheter or sound.

Urethral chill is actually the clinical evidence of acute infection in a chronically inflamed kidney from bacteria delivered into the circulation from an inflamed prostate by means of the trauma of urethral instrumentation. The reason why urethral chill so often does not

inaugurate a chronic sepsis is because the drainage of the urinary passages in the cases of urethritis and stricture, in which urethral chill is most characteristically seen, is usually good, and gives no occasion for prolongation of the acute renal infection.

SYMPTOMS OF PYONEPHROSIS

In its clinical picture pyonephrosis combines the symptoms of chronic pyelonephritis with urosepsis, and sometimes with the more acute symptoms of acute renal infection.

The striking symptoms are usually those of urinary septicemia: mild toxic symptoms if the infection is of low virulence; severe septic symptoms if it is more active.

The Urine.—The urine of pyonephrosis always contains pus. For though the pyonephrosis itself may be closed, the opposite kidney is always infected. If, as is usually the case, the pyonephrosis is open and delivering pus into the bladder, this pus will usually be discharged intermittently. The pus thus delivered is thick, ropy, greenish and settles to the bottom of the urine in a flat mud quite different from the pus of the milder renal infections, and notably different from the lighter pus of cystitis. The renal function is always notably impaired, and even the mixed urine is usually watery and of low specific gravity (Pl. XIII).

Cystoscopy.—This reveals a dilated distorted ureter mouth surrounded by inflammation (though exceptionally this inflammation of the ureter may have subsided, and its mouth look not far from normal), or a golf hole or retracted tunnel-entrance ureter mouth. If the pyonephrosis is discharging pus at the time of the cystoscopy, this pus is likely to appear as a thick, white ribbon drooling from the ureter. If ureter catheterization is possible, in spite of the various kinks and scars in the ureter, the urine obtained from the kidney may show a surprisingly large percentage of urea (as high as 1.5 per cent). But the phenolsulphonephthalein output is always low.

The opposite kidney will habitually be found infected. Usually its function will be found gravely impaired, although it has shown no clinical signs of active inflammation.

Palpation of the Kidney.—Palpation of the kidney which reveals little or nothing in most cases of pyelonephritis, usually reveals a very large kidney, and sometimes a sensitive one if there is pyonephrosis. The increased size of the kidney may be due to the large size of the pyonephrotic sac, but often it is due to the great mass of perirenal fibrolipoma.

There may or may not be pain in the loin.

SYMPTOMS OF PERINEPHRITIS

Fibrolipomatous perinephritis produces no symptoms.

Suppurating perinephritis (perinephritic abscess) produces a clinical picture similar to that of acute renal infection. Indeed since the perinephritic abscess originates, as a rule, in an acute cortical abscess of the kidney, it is quite futile to attempt to distinguish the two too precisely in their earliest stages. But when this acute stage has passed, chronic perinephritic abscess differs markedly in its characteristics from chronic pyelonephritis.

Acute Perinephritic Abscess.—Suppurative perinephritis is usually the result of staphylococcus or streptococcus infection. It results from injury or from any form of staphylococcus or streptococcus septicemia. It is frequently due to furunculosis.

The acute attack begins precisely as an acute renal infection, but often no pus appears in the urine, the function of the affected kidney is not notably impaired, and the infecting organism may or may not be retrieved by culture from the urine of the infected kidney. Chills are common, *renal tenderness and later muscular rigidity* the distinguishing signs. The kidney is likely to be large, and may well be painful as well as tender. Respiration and muscular movements are likely to increase it rather more than is the case with a similar tenderness within the kidney.

If not promptly drained, the patient may die of sepsis, the abscess may become chronic or spontaneous recovery may possibly occur by rupture of the abscess through the skin or into one of the neighboring viscera, or even by resorption of the pus. In view of the safety of surgical treatment, however, it would be madness to delay drainage in the hope of any such happy issue.

Chronic Perinephritis.—Chronic perinephritis doubtless always begins acutely; but the acute attack may be so mild as to be overlooked. Like pyelonephritis it may run a silent afebrile type characterized by an increasing mass in the loin which is often not very tender, and the outlines of which are relatively vague.

More commonly the course of the suppuration is marked by a picket-fence temperature, the patient is gravely septic; but even then he may make no complaint of his loin, and the urine may be free of pus.

In adults chronic perinephritic abscess may be quite definitely distinguished from intrarenal suppuration, though if the suppuration is advanced and the history obscure, it may be quite impossible to tell whether the pus originated within the kidney or from some other retroperitoneal source. The fully developed perinephritic abscess is fixed rather than movable, diffused rather than clear-cut in its outline, asso-

ciated with relatively marked rigidity and even edema of the overlying parietes.

SYMPTOMS OF CERTAIN CLINICAL TYPES OF RENAL INFECTION

Although the pathological and clinical picture already described covers the various types of renal infection whether acute or chronic, whether occurring in infancy or in pregnancy, whether due to urethral or ureteral retention, nevertheless certain clinical types of renal infection exhibit certain dominant characteristics which merit notice. We may enumerate:

Renal infection in infancy.
Renal infection in pregnancy.
Renal infection due to urethral retention.
Renal infection following surgical operation.
Renal infection due to typhoid fever.
Renal infection due to the gonococcus.

Renal Infection in Infancy.—Renal infections[1] are extremely common in infants under two years of age. They are said to be ten times more frequent in girls than in boys. The acute onset may be so mild as to be overlooked, though usually it is very stormy. Thus we may describe the acute and the chronic type of infection.

Acute renal infection in infancy (usually spoken of as the pyelitis of infancy) is usually a stormy attack with chills and high fever, tenderness in the loin, rigidity of the overlying muscles, enlargement of the kidney. These local signs have to be sought for, for the infant does not localize its pain. The debility of the patient is relatively slight as compared with the fever. It is said that malaria and acute renal infection are the only causes of septic fever with repeated chills in infants.

Though the attack is often very acute, it rarely requires surgical treatment. The patients ultimately recover, or pass into the chronic type of renal infection.

Chronic renal infection in infants is a toxemia of the mild digestive type. There may be no fever; there may, from time to time, be acute attacks of infection. The kidney is not likely to be tender. The diagnosis depends upon the examination of a specimen of urine obtained by catheter. Unfortunately the attending physician is very unlikely to think of this means of diagnosis.

Townsend has called attention to the fact that chronic perinephritis

[1] Cf. Friedenwald, *Archiv. of Pediat.*, Nov., 1910; Bremmerman, *Jour. A. M. A.*, Mar. 4, 1911; and Jeffreys, *Quart. Jour. Med.*, Apr., 1911.

occurs in children causing lameness and muscular rigidity as its most striking symptom, and is usually mistaken for spondylitis or hip disease, or even for psoas abscess. The diagnosis can often be made only by operation.

Renal Infection in Pregnancy.—We have as yet no adequate data to help us determine what proportion of renal infections occurring during pregnancy are derived from latent infections of childhood.

The infection may be bilateral, but the acute infection is almost always in the right kidney. The chronic infection is almost always mistaken for toxic albuminuria from which it can only be distinguished by the examination of a specimen obtained by catheter from the bladder.

Acute renal infection occurs on the right side, is more frequent in primiparae than in multiparae. It may occur as early as the third month, but is most common from the seventh to the tenth month. Not a few cases come to operation several weeks after the child is born.

The prognosis of the attack depends almost entirely upon the treatment. Early and appropriate treatment should save the child from premature delivery, the mother from operation.

Renal Infection Due to Retention.[1]—Renal infection is, as we have previously said, usually due to some type of retention. This retention is, in many instances, slight and intermittent. It may be not sufficient to cause any retention of urine in the renal pelvis, but only a congestion of the pelvis and kidney resulting from the slight tension within them. Under such circumstances the dilatation of the kidney pelvis from retention is a very slow process.

But in the type of renal infection of which we are now speaking, the dilatation, due to gross retention, is the predominant feature. The retention may be urethral or ureteral. If urethral, the retention is felt in both kidneys. But a secondary kinking of the dilated ureter may cause an additional retention in one kidney as compared to the other. Thus in urethral cases we may see pyonephrosis of one side, and pyelonephritis of the other.

The retention may come on gradually, or suddenly, the infection may precede the retention, and be lighted up by this, or the retention may exist for some time before infection occurs.

The most interesting type of retention infection is that due to catheterization for the relief of prostatic retention. Such retention, if chronic, may be considerable, and yet may have accumulated so gradually that, previous to the interference of catheterization, the balance of forces may have been so even that the kidneys, as tested by phenolsulphonephthalein, may be working quite well. But the passage of the catheter upsets the balance, excites an acute congestion of the kidney, and prepares the way for the infection that is soon to follow.

[1] Cf. Symposium in *Cincinnati Lancet-Clinic*, 1916, cxv, 118.

The mechanism of this infection has been illustrated on page 290. The kidneys become acutely infected, the output of solids falls, the temperature rises, pus and bacteria appear in the urine. The patient goes into a condition of urinary sepsis more or less grave in proportion to the renal destruction that had preceded infection and the intelligence of the subsequent treatment.

Renal Infection Following Surgical Operations.—Renal infection is likely to complicate the convalescence from surgical operation under three circumstances:

1. The patient has an unsuspected cause of urinary retention, usually prostatism. The acute retention following operation calls attention to this condition for the first time, and starts him on the active symptoms of prostatism.

2. Without any such preëxisting or predisposing cause of retention, the patient's calls to urinate are neglected in two ways. In the first place, while retention is still complete the house staff neglect to pass the catheter as often as is required to keep the patient comfortable. In the second place, when the patient begins to urinate he does not fully empty the bladder, but he is then considered safe from any complications, and no further attention is paid to the bladder retention until infection supervenes.

3. The operation itself may have been a cause of retention or infection. The most annoying type of this condition is that type following the Wertheim operation with stripping of the pelvic ureter for a considerable distance. This results in ureteral atony, dilatation and infection.

It will be noted that each one of these types of retention is due to a neglect on the part of the house staff to appreciate the actual condition present. If a patient has to be catheterized but once or twice after operation, no harm is likely to result. But if continued catheterization is necessary, the case should be looked upon as quite comparable to one of prostatism, and treated accordingly.

Renal Infection in Typhoid.—In the third to the fifth week of typhoid fever, at least one case in three shows typhoid bacilli in the urine. The infection is usually symptomless, mild, and readily controlled by hexamethylenamin. Indeed as a rule it amounts to little more than a bacteriuria without symptoms. But even these mild cases may continue as latent infections for a number of years, and then develop evidences of more severe or even acute infection. Indeed, typhoid infection acts as a mild type of colon infection with the same possibility of acute or grave complications. These patients are more dangerous to others as typhoid carriers than they are to themselves.

Renal Infection Due to Gonorrhea.—Pyelonephritis is not an unusual accompaniment of a severe gonorrhea, but the renal infection is

very rarely due to the gonococcus. The cases I have seen have all but one been due to the staphylococcus or bacillus coli, usually the former.

True gonococcus infection of the kidney is usually mild, but may be tenacious. It seems to be especially amenable to treatment by pelvic lavage.

CHAPTER XXXVI

DIAGNOSIS OF RENAL INFECTIONS

The diagnosis of renal infection presents no great difficulties. That it is so often overlooked is due to the fact that the idea of infection never entered the physician's mind.

The important point, therefore, is when to suspect the existence of renal infection. Perhaps the injunction, "always to be suspicious," would best cover the ground. But one may be more specific, as follows:

Suspect renal infection when:

A child has chills and fever, or chronic indigestion with slight fever.

When a pregnant woman has fever or albuminuria (either during her pregnancy, or during the puerperium).

When an adult has an obscure sepsis, especially if due to furunculosis or if associated with a dry tongue, pyuria or frequent urination.

When a patient with indigestion complains of a dry tongue.

When a patient has frequent and painful urination, and pus in the urine, remember that the diagnosis of cystitis is meaningless unless its cause is known, and that the cause of "idiopathic" inflammation of the bladder is usually inflammation of the renal pelvis.

Under such circumstances the diagnosis of renal infection is made by clinical examination, urinalysis and cystoscopy and the ureter catheterization.

PHYSICAL EXAMINATION

The examination consists chiefly in the ballottement and palpation of the two kidneys as described on page 3. The experienced observer will readily distinguish by palpation between enlargement in the kidney itself, and the less movable, less well-defined, more edematous and boggy enlargement due to perinephritic abscess.

But palpation cannot usually tell us the precise nature of an enlargement of the kidney. Not only may there be pyelonephritis without enlargement, but it may often be impossible to palpate the difference between hydronephrosis, pyonephrosis, compensatory hypertrophy, and neoplasm.

Moreover a tender kidney is not necessarily an acutely inflamed

kidney. A kidney which is the seat of compensatory hypertrophy is often not only painful, but also quite tender.

URINALYSIS

Urinalysis has been almost sufficiently described in the preceding chapter. It will be remembered that an apparently normal urine may be obtained by ureter catheter from an inflamed kidney under two conditions:

1. When there is a staphylococcus or streptococcus focus in the parenchyma threatening to break into the perinephritic tissue, but not communicating with the pelvis, the urine from that kidney may be entirely normal, and its function unimpaired (but the kidney is tender).[1]

2. Latent bacillus coli infection may show no evidence of its presence except the fact that the bacillus may be cultured from the apparently normal urine.

Albumin may be equally absent in cases such as are described above, and even in cases of slightly greater severity. But with the one acute exception noted, any infection of the kidney pelvis worthy of the name includes infection of the parenchyma, and causes albuminuria. Albumin, pus and bacteria form the characteristic combination. The absence of casts is rather the rule than the exception in surgical nephritis.

Thus simple urinalysis goes rather further than simple palpation, and usually tells us that there is, or is not, renal infection. But for a more precise diagnosis we must have recourse to ureter catheterization.

THE URETER CATHETER

With the exceptions noted in the preceding paragraphs, the ureter catheter may be depended upon to give a precise diagnosis of the existence of renal infection. A consideration of the history, presence or absence of fever, physical conditions within the kidney as revealed by palpation, urinalysis, phenolsulphonephthalein estimation, and ureter catheterization, we may usually arrive at a precise picture of the pathological process, and of its bacterial cause.

OTHER AGENCIES FOR DIAGNOSIS

For a more precise diagnosis as to the presence of stone, and of dilatation, and the position of ureteral obstruction, we employ the x-ray, the wax-tipped catheter and pyelography.

[1] Under these circumstances cocci may sometimes be demonstrated in the urine by Crabtree's fractional centrifuge method (p. 13).

DIFFERENTIAL DIAGNOSIS

Diagnosis of the renal infection is readily made with such precision that the question of differential diagnosis only arises in reference to the co-existence of other conditions, such as stone (p. 392), tumor, tuberculosis (p. 423), or infections elsewhere in the body. It must not be forgotten that a renal infection does not exclude an infection elsewhere. A tuberculous kidney is apparently proof against pyogenic infection from other organisms, but the opposite kidney to a tubercular kidney may be thus infected. The co-existence of tumor and infection is rare, excepting in the case of old calculous infections which occasionally lead to carcinoma.

PROGNOSIS

The prognosis of the various types of renal infection has been described with sufficient accuracy in giving the clinical picture. We may once again insist upon the need of immediate operation in the treatment of fulminating acute infection, and of perinephritic abscess.

One must also remember that, not only may a pyelonephritis remain entirely latent for years, but also a more severe inflammation, even though it show a definite amount of albumin and pus in plenty, has a relatively good prognosis in that it may continue for many years without destroying life, if only no intercurrent retention or other complications occur.

CHAPTER XXXVII

TREATMENT OF RENAL INFECTIONS

The principles of the treatment of renal infection are deducible from the general surgical principles involved. The infected kidney is a suppurating cavity, usually a badly drained cavity. Consequently the first and foremost indication is to establish good drainage whether for prophylaxis or for cure, whether by posture, by ureteral or urethral catheter, or by surgery.

The second indication is antisepsis. We must prevent the infection reaching the kidney from bowel, bladder, furuncle, etc. Once the kidney is infected, we ply the patient with hexamethylenamin and perhaps add pelvic lavage by way of local antisepsis. We modify the acidity of the urine and its dilution in order to make it as unfit as possible a medium for the growth of the offending organism.

PROPHYLAXIS

One should be on the lookout for infection of the kidney whenever a patient suffers from constipation, typhoid fever, retention of urine, furunculosis, or any form of sepsis. The prevention of infection from such sources generally means simply the elimination as rapidly as possible of the source of infection. But certain types of prophylaxis require special insistence, as follows:

Prevention of Urethral Chill.—Urethral chill is a possible complication of every passage of an instrument into the urethra. It is inevitable if retention requires a retained catheter or repeated instrumentation. The prevention of infection by gentleness during manipulation, by 1 gram of hexamethylenamin, three times a day, beforehand, and an instillation of 1 : 500 silver nitrate following the instrumentation as described on page 271 suffices when there is no retention. Chronic retention, whether due to prostatism, bladder paralysis, diverticulitis, etc., requires the same gentleness and hexamethylenamin, and also appropriate bladder drainage.

Prevention of Infection by Posture.—Since the so-called spontaneous infections, notably those of infants and young women, are apparently due to renal mobility, these may, except in the case of infants,

be prevented by training in proper posture. The patient should spend at least an hour every day in exercises calculated to expand the lower chest, by throwing the shoulders back, the chest out, the hips in, the abdomen in and the toes in. In addition to this, the patient should be encouraged to lie flat on her back with no pillow under the head, and a small pillow under the lower chest, below the shoulder blades.

TREATMENT OF ACUTE RENAL INFECTIONS

Treatment of Mild Cases.—Infection of a well-drained kidney, even when so severe as a urethral chill, may recover spontaneously without treatment. But if the attack of fever lasts long enough to bring the patient under the physician's observation, he should be put to bed at once, kept upon his back, preferably with no pillow under his head, and with a small pillow under the lower ribs, so as to widen the lumbar recess. After a single purging a colon irrigation once or twice a day will encourage diuresis, and minimize the absorption of toxins from the bowel. The patient's ears, mouth, abdomen and genitals, both internal and external, should be carefully investigated for possible sources of infection.

The medical treatment usually employed consists in the administration of large quantities of water, and of hexamethylenamin. *Hexamethylenamin often does no good* for, like other solids, it is not excreted in any quantity by the acutely inflamed kidney. The water may do positive harm by putting an unnecessary burden of work upon an already impaired organ. It is usually unnecessary to urge more water drinking than is agreeable to the patient.

The administration of large doses of alkali has been employed empirically with considerable success in the treatment of the acute renal infections of children. Potassium acetate or citrate may be given in doses as high as 1 gram, three or four times a day, even to children six or eight years of age. For infants the alkali may be mingled with the colon irrigation fluid, 1 gram being given twice a day.

The alkaline treatment has not proven particularly successful for adults. But it is more efficient than the traditional hexamethylenamin.[1]

For at least a week after the patient is out of bed his temperature should be closely watched as moving about may cause a relapse of the fever, and require a renewed stay in bed.

Treatment of Severe Cases.—The management of the more severe cases of renal infection is extremely trying. The treatment is essentially the same as that described above, but with the temperature soaring

[1] The alkalies pass through the glomeruli and elude the inhibition of function of the tubular epithelia.

occasionally to 105°, or the discouraging relapses after a few days of relatively low temperature, one is tempted to unwise experiments. Thus vaccines have some reputation in the treatment of such cases largely because the patient is likely to get well at about the time the vaccine is employed. Pelvic lavage also has some reputation though it is difficult to see how washing out the cavity of the pelvis should benefit an acute infection of the parenchyma. On the other hand, the single passage of a ureter catheter has frequently been known to cut short the acute attack. Hence this should be employed for therapeutic as well as for diagnostic purposes. In order to avoid any reaction upon the kidneys through the passage of the cystoscope, it is prudent to employ the small single-catheterizing instrument.

Brewer advises decapsulation for doubtful cases which do not seem to require nephrectomy. I have never attempted the operation under these circumstances, and doubt its value.

Treatment of Fulminating Cases.—Let us first define clearly what we mean by fulminating cases. There are three types. In the first, the operative indication is obvious. The patient is overwhelmed by grave septicemia; the temperature runs in the region of 105°, usually with several chills. The treatment is prompt nephrectomy after ureter catheterization has established the sufficiency of the opposite kidney.

But there are fulminating cases in which the patient's condition is, for the time being, apparently very good. Yet there may be on the one hand a temperature rising to 105°, and staying there for two or three days, or on the other hand, a temperature touching that point repeatedly with great oscillation and repeated chills. Either condition is an indication for operation. Exploration will usually reveal a large purple organ riddled with foci of suppuration. Partial nephrectomy is unsatisfactory patchwork.

Treatment of Perinephritic Cases.—Certain cases, especially those causing fever, a large and tender kidney, and no pus in the urine, require early operation for the drainage of the abscess in the parenchyma and the perinephritic abscess adjoining. These cases escape nephrectomy if drained early.

DECAPSULATION FOR NONSURGICAL NEPHRITIS

The Effect of Decapsulation upon the Kidney.—The disappearance of albuminuria after an operation performed for surgical disease of the kidney has been noted by various authors, and is not a very uncommon experience. In 1901 Edebohls,[1] having observed these facts in a number of nephropexies, conceived the idea of aiding the return

[1] *Med. Record,* 1901, lx, 690.

to normal of the kidney by stripping from it its fibrous capsule, on the theory that tension would thus be relieved and that the new capsule formed from the cellular tissue about the kidney might prove more vascular than the old, and thus supply more blood to the kidney.

Following out this theory, at first chiefly upon cases of albuminuria associated with nephroptosis, later upon all kinds of albuminurics, Edebohls [1] reported, in 1903, 51 cases, of which 14 per cent died, 44 per cent improved, and 14 per cent were definitely cured. But, in the meanwhile, Rovsing [2] by a series of careful investigations, demonstrated that bacterial nephritis (i.e., pyelonephritis), or nephritis causing renal pain or hematuria, could be cured by nephrotomy with decapsulation, but that true Bright's disease, nonsurgical nephritis, could not be so cured.

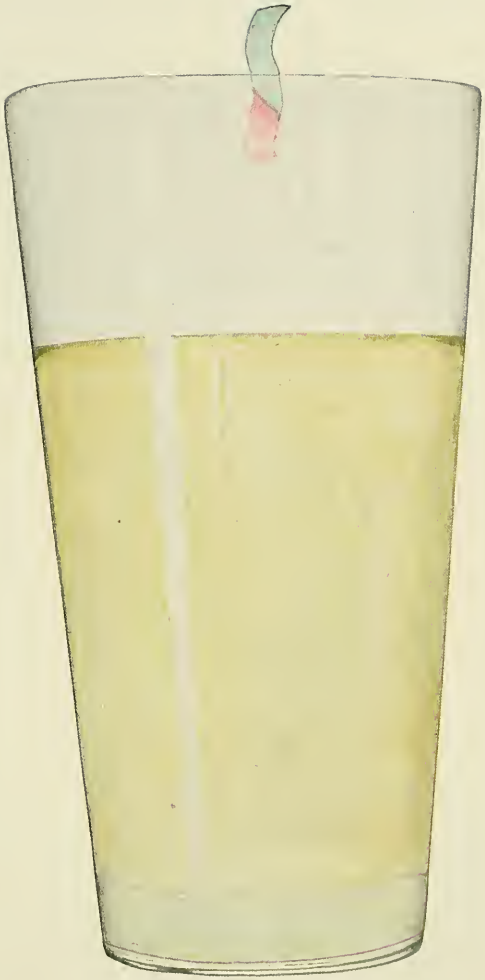
Experiments upon dogs, rabbits, and cats have shown that the capsule of scar tissue formed after decapsulation, although more vascular at first, soon develops into a fibrous layer closely resembling the original capsule, and is, if anything, more closely adherent to the kidney. Autopsy reports are few and conflicting, but in the main confirm this view.

Elliott [3] collected 112 reported decapsulations, among which 29 cases of nephroptosis, with albuminuria, operated upon by nephropexy with or without decapsulation. Almost all did well. His 76 cases of medical nephritis show 36 deaths, 14 unimproved, 26 improved (?). Unfortunately most of the cases were last reported within six months after operation. Improvement for this brief space is doubtless due to the relief of congestion. Indeed the benefit derived from decapsulation is apparently due solely to this relief of congestion, not to any permanent change in the blood supply.

Edebohls [4] has operated upon 103 cases and observed the survivors for at least fifteen months. Of these, 11 died as a result of operation, 29 more of chronic nephritis, and 10 more from other causes. Of the 53 survivors, Edebohls estimates 11 as improved, 33 as cured. Edebohls' definition of a cure is the absence of symptoms of nephritis and entirely normal urine for six months. That only 18 of these patients were "cured" within a year of the time of operation probably shows, contrary to Edebohls' opinion, how independent of operation these so-called cures are.

It is the consensus of opinion that decapsulation may be beneficial to the acutely congested kidney, whether the congestion be bacterial or toxic, but that it is of no service in chronic nephritis.

[1] *Med. Record,* 1903, lxiii, 481.
[2] *Mitteil. aus d. Grenzgebiet. d. Med. u. Chir.,* 1902, x, 288.
[3] *N. Y. Med. Jour.,* 1904, lxxix, 1078.
[4] *Jour. A. M. A.,* 1909, lii, 195.



THE URINE OF PYONEPHROSIS.

The urine is acid and milky when passed. On standing it becomes almost clear, retaining only a bacterial haze, while the pus accumulates in a flat, cohesive, yellow or greenish mass at the bottom. The specific gravity of this urine is low, and the amount of pus varies from day to day.

TREATMENT OF PYELONEPHRITIS WITHOUT RETENTION OR SEPSIS

The treatments usually employed are: hygiene, hexamethylenamin, pelvic lavage and vaccines.

Hygiene.—The hygiene is that of chronic nonbacterial nephritis. If the kidney function is definitely impaired, the patient's weight should be reduced by a diet free from alcohol and with low proportion of nitrogen. His health may be expected to improve if he keeps in the open air, avoids worry and hard physical and mental exertion.

Hexamethylenamin.—Hexamethylenamin is all but synonymous with urinary antisepsis. The other drugs employed for this purpose have never been proven to have any value.

Hexamethylenamin is a combination of ammonia and formaldehyd. Its only effect is an antiseptic one, due to the liberation of formaldehyd from it in acid solution. Hence it is only efficient in the stomach and in the urine. The liberation of formaldehyd in the stomach is merely an inconvenience on account of its irritating properties. This inconvenience may be overcome by administering the drug in salol- or keratin-coated capsules. The observations of Burnam,[1] George Smith,[2] Hinman,[3] and others have shown that in order to have any antiseptic effect, the formalin liberated in the urine must be in a concentration of at least 1: 30,000. The drug must be administered in doses of at least 1 gram, three times a day, to obtain this concentration.[4] Inasmuch as the drug breaks up rather slowly, it is questionable whether it is often antiseptic in the kidney pelvis at this dose (Hinman). It is likely to have no value in acute nephritis, for the excretion of solids is notably reduced under these circumstances, so that the excretion of hexamethylenamin must be very small.

The theoretically ideal dose is 2 grams, four times a day. The effect of this may be distinctly increased by the administration of acid phosphate of sodium, 2 to 3 grams a day in order to increase the acidity of the urine. The maximum excretion of the drug occurs within a few hours of its administration.

It may seem wise to control the administration of hexamethylen-

[1] *Archiv. of Int. Med.*, 1912, x, 324.

[2] *Boston Med. & Surg. Jour.*, May 15, 1913, clxviii, 713.

[3] *Jour. A. M. A.*, Nov. 20, 1915, lxv, 1769.

[4] There are very rare exceptions to this rule. Persons who are irritated by small doses of hexamethylenamin sometimes obtain unquestioned antiseptic effect from still smaller doses. I have known a patient who could not keep his urine clean in any other way to keep it free from pus for years by doses of hexamethylenamin of less than a gram a day.

amin by Burnam's test for formalin in the urine. Thereby we may estimate the proper amount in order to get a given result. But practically speaking, the susceptibility of different individuals to the toxic action of the drug varies greatly. The liberation of too much formalin in the urine produces frequent and painful urination, and even hematuria. Warren Coleman [1] has collected a number of cases of hematuria following the administration of very small doses. A single dose of less than a gram has several times caused this result. But so rare is this phenomenon that it is usually safe to begin with a dose of 1 gram, three times a day, and increase until the limit of toleration is found. If the urine is not acid, the administration of the drug is accompanied by 1 gram, three times a day, of acid sodium phosphate. When the limit of toleration is found, the drug is administered at a point just below this. If no benefit is obtained in the course of a week or ten days, the drug may as well be abandoned.

Pelvic Lavage.—The pelves of the kidney may be washed out through a ureter catheter, once or twice a week. The most valuable solution for this purpose is silver nitrate in strength of from 0.5 to 1 per cent. Not more than 2 c.c. should be injected, and this should be permitted to run out through the ureter catheter. Geraghty [2] has advised that silver be used in as high as 5 per cent strength. This is very painful, but he states that it cures certain cases that are not cured by the milder solutions.

Pelvic lavage should not be employed in acute cases, in cases with retention of urine in the kidney pelves, in cases with definite impairment of the function of the kidney as estimated by the phenolsulphonephthalein output. Under favorable circumstances, it is even claimed (e.g., by Geraghty) that favorable cases may be actually cured even of a bacillus coli infection by this lavage. Their active symptoms may certainly be relieved.

Vaccines.—Vaccines, whether autogenous or stock, are of no value in this class of cases.

Summary.—As an actual fact the great majority of the mild cases of renal infection, without sepsis or grave retention, do not even come for treatment. They consider themselves practically well. And the most mildly infected suffer so little, and are offered so little prospect of help by any treatment that one cannot blame them for shirking. I have relieved, but never cured, such cases by the method of pelvic lavage. I have also known them to be relieved by high doses of hexamethylenamin. I have seen two cures result from treatment at a diuretic spring where the patient for several weeks drank very large quantities of water.

[1] *Medical News,* August 29, 1903.

[2] *Jour. A. M. A.,* December 19, 1914, lxiii, 2211.

TREATMENT OF PYELONEPHRITIS DUE TO RETENTION OR CAUSING SEPSIS

Whenever renal retention is diagnosed the relief of this constitutes the first step in the treatment of any renal infection, acute or chronic, mild or severe. The general topic of renal retention is discussed under the head of "Hydronephrosis." But renal retention is often silent until infection produces symptoms.

The following observations may prove suggestive in the treatment of such cases.

In Children.—In children the relief of renal retention is accomplished by postural exercises as already described. So long as there is no stone, gross dilatation of the kidney is not likely to be found excepting in rapidly fatal congenital cases.

In Pregnancy.—Decubitus with a pillow under the lower chest may relieve pressure in pregnancy. If this fails, drainage should be obtained by *the indwelling ureter catheter.* It is scarcely ever necessary, either to perform nephrectomy for a fulminating condition (I have performed one such), or to terminate the pregnancy. Patient and intelligent care, and above all an early recognition of the fact that the patient's albuminuria is due to retention and infection, and not to Bright's disease, should carry her through her pregnancy safely.

Urethral Retention.—This is a common cause of renal infection. The treatment of the various types of urethral retention need not be specified here. One must not forget, however, that a virgin may have retention of urine due to cystocele, that this condition is very common in old women, and that stricture of the urethra is very commonly overlooked in women. The fact that a glass catheter will enter the bladder by no means shows that the woman has not a stricture. Her urethra should normally take a 24 to 26 sound.

It is most essential to remember that a primary cause of retention in the urethra or lower ureter may so dilate the canal above as to cause secondary kinking and pouching of the upper ureter and kidney pelvis. Under such circumstances, the relief of the lower retention does not accomplish a cure. One sees this commonly in cases of pyonephrosis due to urethral stricture or prostatism, the pyonephrosis being kept up by a ureteral kink after the urethral retention has been relieved. Stricture at the ureter orifice or stone impacted for a long time in the lower ureter has a similar effect in some instances.

Nephropexy may cure infection due to slight retention. Pyelography and careful examination of the kidney pelvis and ureter for kinks, adhesions and dilatations in the course of the operation will reveal the precise condition in many such cases.

TREATMENT OF URINARY SEPTICEMIA

The treatment of acute renal infection, including urethral chill, has already been described.

Urinary septicemia usually depends upon some form of retention of urine (whether urethral or ureteral). The first requisite for a cure is the relief of this retention.

The treatment of pyonephrosis is so special that it is described separately.

Vaccines.—Vaccines are of no value excepting for the relief of toxic symptoms. I have known patients to derive great temporary comfort from the use of vaccines, but have never seen any permanent good results, and have never known the bacteria or the pus to be driven from the urine by their use. Generally speaking, they are not worth while, if not worse than useless in that they encourage neglect in searching out the real treatment; i.e., the relief of the retention.

Pelvic Lavage.—Lavage of the kidney pelvis is as little calculated to do good when there is chronic retention or chronic sepsis. The benefits attributed to the lavage are doubtless usually due to the passage of the ureter catheter. For it is in these cases especially that the ureter catheter is singularly valuable. *The indwelling ureter catheter* will often not only carry one by a difficult stage of relatively acute infection, but will also so improve the ureteral drainage that the subsequent course of the case is singularly modified for the good.

Diuresis.—After the retention has been overcome, catharsis and diuresis are the best means in our possession for the combating of infection and sepsis. In really acute cases diuresis may do more harm than good if it is pushed to the point of adding to the congestion of the kidney. Indeed it may be overdone even in chronic cases. But while there is actual sepsis the patient may often with advantage drink 8 to 12 glasses of water a day, and receive one or two colon irrigations. The Murphy drip is also useful, and for emergencies intravenous or subcutaneous infusions.

But it is to be remembered that the object of diuresis is simply to free the kidney of solids; to keep the urine at relatively low specific gravity; to do exactly what catharsis does in the intestines. The practice of depending upon water alone for the purpose of washing bacteria out of the kidney is scarcely justified. It often keeps the patient sick, or makes him sicker by adding to the work thrown upon the kidney.

TREATMENT OF PYONEPHROSIS

Pyonephrosis is a surgical condition, its treatment is operative. It usually requires nephrectomy, but some cases recover after nephrotomy, and many die after nephrectomy because of their sepsis and of the deficient function of the opposite kidney. Therefore, one may specify as follows:

Unless the function of the opposite kidney is found to be perfectly adequate, nontubercular pyonephrosis should always be drained for a time before nephrectomy is undertaken. Inasmuch as the kidney is usually large, the drainage may be established without disturbing the kidney in its bed.

If the pyonephrosis is acute, and the pus in the kidney has accumulated rather as a result of an active suppuration than as a result of a stoppage in the ureter, this simple drainage may cure this condition by evacuating the thick pus.

If, as is usually the case, drainage does not cure, it should be continued until the patient's general condition and the function of the opposite kidney have improved as much as may be expected; then nephrectomy is performed.

Plastic operations about the upper end of the ureter are not to be considered as a means of curing pyonephrosis.

TREATMENT OF PERINEPHRITIS

Fibrolipomatous perinephritis requires no treatment.

Perinephritic abscess should be diagnosed and drained as early as possible. If the case is really seen early the focus in the kidney can usually be identified and curetted so that it may drain freely. Whether it is wise to carry the incision into the pelvis of the kidney for the purpose of drainage will have been decided by the observations made by ureter catheter before the operation.

In early cases the situation of the suppuration within or without the fascial capsule of the kidney will show whether its origin is renal or not. But if the abscess is of long standing, the primary effort should be simply to drain it, leaving the treatment of other lesions for subsequent consideration.

The necessity for nephrectomy is determined by the condition of the kidney. It is usually wise to postpone nephrectomy until drainage shall have relieved the patient of his sepsis.

CHAPTER XXXVIII

CYSTITIS

The inflammations of the bladder are reducible to a very small number of clinical types, though each of these types has many variations. Authorities differ so widely in their classifications of cystites that an accepted classification can hardly be said to exist. The following simple scheme will suffice for our purposes:

- Nonbacterial Cystitis
  - Traumatic.
  - Chemical.
- Bacterial Cystitis: Simple
  - Acute.
  - Chronic
    - Alkaline.
    - Acid.
  - Interstitial.
  - Pericystitis.
- Tubercular Cystitis

The nonbacterial cases will be dismissed briefly. Tubercular cystitis is considered in a subsequent chapter.

NONBACTERIAL CYSTITIS

Nonbacterial cystitis is the reaction of the vesical mucous membrane to a mechanical or a chemical irritant.

Traumatic Cystitis.—A severe inflammation without infection may be caused by stone in the bladder and by rough instrumentation. In such cases there may be much tenesmus and distress together with blood and pus in the urine, and yet no true infection.

Treatment.—The irritation may be dispelled by removing the cause. It may be mitigated by balsamics and anodynes.

Chemical Cystitis.—Any strong irritant entering the healthy bladder, whether from above or below, causes cystitis. The intense strangury caused by the administration of cantharides has acquired an undeserved notoriety on account of the alleged sexual excitement accompanying it. The acute prostatic congestion induced by this drug is said to cause priapism, but the sensations of the patient in this condition are

anything but pleasant. Rehn, and later Lichtenstein,[1] have called attention to a similar strangury occurring in coal-tar workers, apparently due to inhalation of irritating vapors. Sarcoma of the bladder occurs in some of these cases. The irritation due to hexamethylenamin is more important, since that drug is so freely used nowadays.

While hyperacid urine is somewhat irritating to the bladder, ammoniacal urine is far more so, and the reason why an ammoniacal cystitis is likely to be so much more intense than an acid cystitis is doubtless for this very reason—that the ammonia adds fuel to the fire of bacterial attack.

Cystitis may equally be caused by irritants introduced through the urethra. Nitrate of silver is so often used in concentrated solution that it bears an unenviable notoriety in this regard. Such chemical cystitis may be followed by true infection of the bladder and also of the kidney. Mock [2] has reported two cases of gangrene of the bladder following injections made in the hope of producing abortion.

Treatment.—Removal of the cause constitutes the essence of treatment. To allay the irritation the sedative remedies employed in bacterial cystitis may be used.

BACTERIAL CYSTITIS

Cystitis may be acute or chronic, superficial, interstitial, or complicated by pericystitis.

ETIOLOGY

The etiology of cystitis has been considered in Chapter XXXIII. The conclusions therein reached may be summed up as follows:

1. Bacteria may reach the bladder (1) from the urethra, (2) from the kidney, and less often (3) by irruption of a neighboring focus of inflammation, and (4) from the blood or the lymph vessels.

2. Bacteria reaching the bladder will not cause any inflammation of that organ unless there is congestion due to (1) retention, (2) trauma by instruments, stone, or foreign body, (3) disease of the bladder wall, such as neoplasm, tubercle, or simple ulcer, or (4) unless the disease extends directly to the bladder from the neighboring tissues, the ureter (tuberculosis) or the urethra (gonorrhea), or (5) unless the bladder is paralyzed.

3. A cystitis thus begun will disappear spontaneously unless it is perpetuated by some of the accessory causes enumerated.

4. Acid cystitis is usually caused by the bacillus coli, the tubercle

[1] *Deutsche med. Wochenschr.*, 1898, xxiv, 709.

[2] *Guyon's Annales*, 1911, xxix, 1633.

bacillus, the typhoid bacillus, or the gonococcus. Alkaline cystitis is due to staphylococcus, streptococcus, or proteus infection. Exceptionally these bacteria cause only an acid cystitis.

5. Mixed infection is much more frequent in the bladder than in the kidney. The pyogenic cocci predominate, and the flora of cystitis is much more variegated than that of pyelonephritis. Thus I have seen a case of cystitis due to direct extension of erysipelas from the vulva. Luetscher [1] reports cases due to bacillus lactis aërogenes (I have seen one such). Chute [2] reports an infection due to penicilium glaucum.

PATHOLOGY

The lesions of cystitis are usually unevenly distributed over the bladder. Indeed, in many acute or mild chronic cases the lesions are entirely confined to the neck of the bladder and the trigone. This so-called inflammation of the neck of the bladder is commonly due in men to some prostatic inflammation, which latter must be attacked in order to cure the "inflammation of the neck." It may be noted here that in every cystitis, whether acute or chronic, the prostatic urethra (and in women practically the whole urethra) as well as the bladder is inflamed, and the vesical inflammation is most intense about the neck and the trigone, unless some special feature of the disease (tumor, stone, pouch) produces a distinct focus of more intense inflammation elsewhere in the organ.

Acute Cystitis.—At first there is a sharp congestion most marked about the trigone and the neck, or entirely confined to that region. The mucous membrane is swollen and bright red in color. The capillaries are dilated, the epithelial cells swollen. Then the epithelial cells begin to desquamate. The angry crimson of the mucous membrane is blotched by petechiae, its gloss is lost, and here and there vesicles or superficial abscesses appear. After these break minute ulcers remain. If the acute condition persists the muscular and peritoneal coats may become infiltrated (interstitial cystitis).

Chronic Cystitis.—The *mucous membrane* is irregularly thickened and dense. Its surface is rough, red in color, perhaps mottled by purple or brownish blotches left by submucous hemorrhages. There may be areas of ulceration and granulation. Sometimes the granulations grow to be distinct little villosities several millimeters long. The ulcerations may extend deep into the substance of the organ and communicate (rarely) with abscesses in the muscular tissue. In long-standing cases the epithelium may become cornified in spots, the superficial epithelia being replaced by dense shiny scales resembling the

[1] *Bull. Johns Hopkins Hosp.*, Oct., 1911.

[2] *Boston Med. and Surg. Jour.*, Mar. 22, 1911.

horny layers of the skin (*leukoplakia vesicae*). The ulcers may be coated with adherent phosphates. Cystitis cystica and cystitis granulosa (cf. p. 371) are perhaps the result of chronic inflammation.

Gross Changes in the Wall of the Bladder.—In prolonged chronic cystitis the wall of the bladder becomes thickened or thinned, its cavity contracted or dilated, its surface thrown into folds of mucous membrane overlying irregular interlacing bands of muscle fiber.

The resulting changes are described as hypertrophy (thickening) or atony (thinning) of the bladder. Hypertrophy of the bladder may be concentric (cavity contracted) or eccentric (dilated). The irregularities in the bladder wall are spoken of as trabeculae (trabeculated bladder) or diverticulae (sacculated bladder) (p. 538). Diverticulae extend through the entire thickness of the bladder wall; they are often congenital. Trabeculation occurs in all cases of prolonged chronic cystitis.

Microscopic Changes in the Bladder Wall.—The microscopic changes in the muscle of the bladder afflicted with chronic cystitis have been shown by Ciechanowski to be almost purely sclerotic whether this muscle be thick and apparently hypertrophied or thin and manifestly atrophied. When apparently hypertrophied the increased thickness of the bladder wall is only due in very small degree to actual muscular hypertrophy. It is chiefly due to inflammatory infiltration and sclerosis of the muscle as well as of the interstitial tissue between the bundles of muscle fiber. The so-called "hypertrophied" bladder may be as feeble as the atrophied bladder. The hypertrophy is a false hypertrophy.

The various degrees of hypertrophy and atrophy are due to the interplay of inflammation and retention. If the retention is slight or absent and the inflammation severe, the bladder undergoes concentric hypertrophy. If retention is marked and inflammation severe, eccentric hypertrophy results. If retention is marked and inflammation mild, dilatation and atony result.

Pericystitis.—The changes that occur in the connective tissue surrounding the bladder are usually of a protective character. An intense chronic cystitis often provokes a thickening of the perivesical tissue and of the peritoneum. Less frequently a diffuse fibrolipoma occurs, comparable to the perirenal fibrolipoma, and, like it, protective in character. In such cases the fibrous masses may often be felt through the rectum, and I have known them to be mistaken for cancer of the prostate until cystotomy showed the prostate to be normal and the whole bladder to be thickened. When there is much pericystitis the bladder is usually found in a state of concentric hypertrophy with fibrous, undistensible walls.

Suppurative pericystitis is usually due to trauma.

Abscess.—Abscess of the bladder is rare. Small abscesses of the

mucous membrane may run their course unnoticed. Abscesses within the wall of the bladder may begin in some infected interstitial focus or in a pocket of the mucous membrane. They burst into the bladder, leaving deep necrotic pockets, which may continue to suppurate indefinitely, or lead to perforation. Purulent venous thrombosis has been seen.

Membranous Cystitis.[1]—*Exfoliation of the mucous membrane,* partial or complete, may occur as the result of an intense cystitis or of trauma. It is rarely seen except as a complication of prolonged and difficult parturition, or as a post mortem finding in patients who have died septic.

SYMPTOMS

The three accepted symptoms of cystitis are:

1. Pus in the urine (pyuria).
2. Frequency of urination.
3. Pain; notably pain with urination.

But of these only one—viz., pyuria—is constant. Pus, frequency, and pain may be due to chronic posterior urethritis without cystitis or to pyelonephritis without cystitis. If the condition is acute, this triad does indeed suggest cystitis; but *chronic pyuria, frequency, and pain, in the absence of retention, suggest prostatitis or pyelonephritis rather than cystitis.*

Hematuria if solely due to cystitis is slight, even microscopic, and tends to appear at the end of urination (terminal hematuria).

Systemic Disturbance.—Though patients suffering from cystitis often exhibit such symptoms as chills, fever, sleeplessness, anorexia, and loss of flesh and strength, these symptoms are not directly referable to the inflammation of the bladder. The febrile symptoms are due either to inflammation of the prostate or to implication of the kidneys, and the loss of appetite, sleep, and strength is due to the distressing symptoms of pain, dysuria, and tenesmus.

TYPES OF THE DISEASE

Cystitis is not a disease. The normal bladder is singularly resistant to infection. The trigone readily becomes inflamed by extension of inflammation from the urethra or the ureters. Thus the cystoscope not infrequently reveals a trigonitis of urethral origin in the female, and would reveal it far more often in the male did we not fear to cystoscope patients during gonorrhea. Also the inflamed ureter mouth with adjacent trigonitis is a familiar cystoscopic picture. But even

[1] Cf. O'Neil, *Trans. Am. Assn. Genito-Urinary Surg.,* 1909, iv.

such inflammations commonly remain localized and do not properly constitute a cystitis unless retention, trauma, stone, or tumor make the bladder vulnerable.

Cystitis, whether acute or chronic, is always a secondary infection, dependent upon something else; we should never think of it as primary. When we do we are often using the word "cystitis" to cover some important pathological fact such as infection of the kidney. For instance, acute gonorrheal cystitis is a matter of no importance; the important lesion is the acute gonorrheal prostatitis. Acute postoperative cystitis is a matter of no importance; the important thing is the retention, the important inflammation the acute renal infection. The same is true of the colon cystitides. The cystitis of childhood, the cystitis of pregnancy, etc., are usually nothing more than names to hide a renal infection. A study of 88 cases of chronic cystitis in women by G. G. Smith [1] is excellent statistical evidence to this effect.

Therefore, let it be understood that in speaking of cystitis we use the term with the greatest reserve and, though recognizing that cystitis may, under unusual conditions or for brief periods of time, exist as a separate entity, we prefer to think of it rather as a lesion accessory to a urethritis, a prostatitis or an infected kidney.

Acute Cystitis.—Acute cystitis is characterized by very frequent and very painful urination both by day and by night; the act of micturition terminates in a series of exquisitely painful spasms, efforts of the inflamed bladder to squeeze out a few drops of urine more after it is actually empty. The urine contains pus and bacteria, usually blood. The blood may be mixed throughout the urine, or may be terminal (a few drops of almost pure blood coming at the end of the urinary stream).

Such an acute cystitis is usually due to the passage of instruments (in which case, if not complicated by retention, it subsides in the course of a few hours), to retention (p. 297), to gonorrhea (see p. 171), to tuberculosis (see p. 420), or to stone (p. 405).

Chronic Cystitis.—Chronic cystitis is, as stated above, essentially secondary to some other lesion.

It may produce no symptoms; thus the patient with a paralyzed bladder, whose symptoms are under control by catheterization, may show quite an intense cystitis to the cystoscope, but have *no* subjective *symptoms whatever. The urine merely contains pus;* there is no frequent or painful urination.

It is characteristic, however, that the inflamed mucosa does not stretch as kindly as the uninflamed bladder, consequently the intervals between urinations are usually short, and each urination not free from discomfort. *There is frequent and painful urination and pus in the*

[1] *Jour. A. M. A.*, December 6, 1913, lxi, 2038.

urine. The intensity of these symptoms usually depends upon the retention, stone, etc., causing the cystitis.

We speak of acid and of alkaline (or ammoniacal) cystitis; the former is usually caused by the bacillus coli, and is mild, almost symptomless. The latter, usually caused by the ammoniogenic pyogenic

Fig. 70.—Cystitis Cystica Adjacent to a Carcinoma of the Bladder.

cocci or proteus, fills the urine with ropy mucopus, and is likely to cause a violent infection with great pain, great frequency, and the passage of blood. Ammoniacal cystitis is uncommon except in the presence of retention and of stone. The same microörganisms that break up the urea when there is retention or stone fail to do so when these conditions are relieved; the patient subsides into a mild condition of acid cystitis in which the pyogenic cocci or proteus may nevertheless be found (p. 319).

Ulcerative Cystitis.—Inflammatory ulcers may result from any rather acute cystitis; moreover the chronic ulcer of the vesical vault

in young females described by Hunner (p. 436) is doubtless inflammatory in origin. Another type of ulcerative cystitis due to the pyogenic cocci shows little insignificant superficial aphthous-looking ulcers scattered about the mucous membrane of the bladder. I have seen this type of inflammation only in women. It causes great frequency and pain, and may not be associated with any generalized inflammation.

The lesion usually classified as simple ulcer of the bladder is better termed:—

Incrusted Ulcerations.—Ulcerations due to stone, to operation or to tumor may become incrusted with deposits of phosphatic salts. Similar incrustations occur spontaneously, doubtless as the result of severe chronic inflammation. Those I have seen have been situated near the neck of the bladder, the ulcer itself consisting of a deep mass of granulation tissue occupying the whole thickness of the mucous membrane; exquisitely sensitive, bleeding at the slightest touch, and covered either wholly or in part by a thick and very adherent mass of phosphatic crystals. The ulcer is surrounded by an angry raised border and presents an appearance strongly suggestive of malignancy. The symptoms of incrusted cystitis are most severe; the patient passes off small masses of phosphates from time to time.

Cystitis Cystica and Granulosa.—Cystitis cystica and cystitis granulosa (two entirely independent pathological conditions) are perhaps due to chronic inflammation (Fig. 70).

They occur both in the bladder and in the kidney pelvis and ureter (p. 337); the precise cause is unknown; they are usually associated with slight pyuria, and with renal or vesical irritation (frequency of urination). Sometimes the symptoms due to them are quite marked. They may give rise to long-continued hematuria.

Leukoplakia.—This, like the two conditions just mentioned, may occur in the kidney pelvis or in the bladder; it is quite obviously due to chronic inflammation in the urinary organs; it does not seem to give rise to carcinoma as it does upon the tongue. It causes chronic pyuria with frequent and painful irritation, and perhaps hematuria.

Interstitial Cystitis.—Inflammation of the bladder muscle is the result of prolonged retention or prolonged severe cystitis. It cannot be said to have any clinical picture, although when the bladder is greatly contracted we know that there is interstitial cystitis.

Pericystitis.—Adhesive and fibrolipomatous pericystitis gives no symptoms.

Suppurative or phlegmonous pericystitis may result from infection within the bladder (stone, diverticulum, retention) or may arise from the adjacent organs (appendix, fallopian tube, vas deferens) or from trauma (operation, fracture of the pelvis, rupture of the bladder) or from the prostate or seminal vesicles. (Tubercular pericystitis is un-

common.) The infection may be localized in the space of Retzius or in the region above the prostate. General symptoms of septicemia predominate the clinical picture; a mass may be felt above the pubes or above the prostate, suggesting carcinoma.

The course of the infection may be acute with irregular temperature; very frequently it is extremely chronic. There is likely to be cystitis as well.[1]

DIAGNOSIS

The diagnosis of cystitis is meaningless unless accompanied by a diagnosis of the associated renal or urethral or prostatic infection or unless attributed to stone or tumor.

Pyuria in the presence of retention or bladder stone or tumor means cystitis and pyelonephritis as well. The precise diagnosis can only be made by the cystoscope.

Cystoscopic Picture.—Acute cystitis shows a brilliant red, ecchymotic, ulcerated mucous membrane. Mild chronic cystitis is characterized by disappearance of the blood vessels that should be seen coursing in the mucous membrane. When the cystitis is more chronic, the mucous membrane looks granulating and ulcerated, and is of a deep red color.

Cystitis cystica and granulosa appear as little rounded red discrete or agglomerated bodies, the precise nature of which can only be distinguished when they are excised and examined under the microscope. Leukoplakia appears as white, thick irregular patches (similar to those seen upon the tongue and cheeks); ulcers are readily recognized, incrusted ulcers look distinctly carcinomatous and are diagnosed by cystoscopic excision.

TREATMENT

Prophylaxis.—Prevention of cystitis is an important element in the treatment of prostatitis, stricture, prostatism, bladder stone and tumor, as well as in every passage of an instrument into the bladder. It requires no special notice here.

Treatment of Acute Cystitis.—The cause of the inflammation should be removed if possible. If not the patient is put to bed, medicated with balsamic and anodyne (p. 221) and with hot rectal irrigations (p. 209).

For local treatment instillations of argyrol, carbolic acid, and silver nitrate may be of use. The first is sometimes singularly soothing, and may be repeated as often as twice a day; 20 drops of a 20 per cent solution. If this fails, 5 drops of 2 per cent carbolic may be

[1] Cf. Chute, *Boston Med. & Surg. Jour.*, 1909, clxi, 438.

tried once. For gonorrheal cases 2 drops of a 2 to 4 per cent solution of silver nitrate is peculiarly soothing.

It is scarcely necessary to add that none of these remedies will be efficacious unless retention is relieved.

Treatment of Chronic Cystitis.—The peculiarity of chronic cystitis, depending, as it always does, upon some other morbid condition, renders its special description unsatisfactory, and begets a necessity for constant reference to the other affections which underlie it. A reference to the sections on those diseases with which cystitis is especially associated, notably prostatism, stricture, and stone, will give a better foundation for treatment than anything that can be said here.

In general, the radical treatment of chronic cystitis consists in removal of its cause. If the cause is not removable, or if it has been removed, the treatment is palliative. Attention to the general health, the urinary hygiene, the condition of the bowels, and the quality of the urine, constitutes the essential background, the passive part of the cure, as it were, while the active work is performed locally.

The Urine Must be Modified.—Its specific gravity should be kept below 1.020—below 1.015, if possible. This object is attained by making the patient drink water. Some balsamic is administered, together with an alkali, as in the treatment of acute gonorrhea.

Chronic ulcerative cystitis, due to the pyogenic cocci, is very rebellious. I have cured cases by instillations of 2 per cent carbolic acid, by injections once a day of 5 c.c. of a culture of the bacillus acidophilus, by instillations of 2 c.c. of 20 per cent argyrol once or twice a day and by injections of acetic acid as strong as the patient can bear (1 : 500 up to 1 : 200).

Incrusted ulcers may be cured by similar treatment. I have cured one case by picking off the incrustations with a cystoscopic forceps, one by curetting through the female urethra, followed by cystoscopic forceps, two by acidophilus bacillus, and one which resisted all treatment got well spontaneously with the casting off of the incrustations three months later. I operated upon two cases suprapubically; one died of hemorrhage, the other relapsed, and was cured by the acidophilus bacillus.

Suprapubic incision and curettage or excision of the affected areas is the only treatment for cystitis cystica and granulosa, and for leukoplakia. It is not brilliantly successful.

Interstitial cystitis, causing contraction of the vesical cavity, is best treated by relieving the retention or other cause of cystitis; with the amelioration of the inflammation the bladder is likely to expand somewhat. Mechanical efforts to dilate the bladder are doomed to failure.

Suppurative pericystitis requires free suprapubic drainage.

The Local Treatment Is the Most Important.—This is the active, efficient part of the treatment from which a cure is expected; it must be systematic and intelligent. The more acute or recent the inflammation the more advantage there is in using instillations and in pushing the strength of the solution to the limit of toleration. I have had most success with nitrate of silver and permanganate of potassium. Chronic, long-standing cases cannot be cured unless the cause of inflammation is removed. Ammoniacal inflammation may sometimes be overcome by vigorous local treatment, and the attempt should always be made, as the patient is far safer with chronic acid cystitis than with chronic alkaline inflammation.

CHAPTER XXXIX

URINARY CALCULUS: VARIETIES—ETIOLOGY—TREATMENT OTHER THAN RADICAL

A URINARY stone, or calculus, is a body resembling a stone in its general characteristics, and formed of crystalline urinary salts (exceptionally of other substances) held together by viscid organic matter, and showing, microscopically or to the naked eye, a laminated structure.

FIG. 71.—SECTION OF A PHOSPHATIC CALCULUS, SHOWING EXCENTRIC DEVELOPMENT.

FIG. 72.—URIC ACID CALCULUS (SECTION). The marked central lamination suggests a preponderance of uric acid, while the more amorphous periphery shows an intermixture here of urates.

True calculi are composed of a nucleus, single or multiple, and layers more or less concentric of the same or of another material arranged around it (Figs. 71, 72, 73). This is the case for large as well as for microscopic calculi, even for those requiring a magnifying power of 250 diameters (Beale) to make out their lamination. This fact of lamination alone differentiates calculus from *gravel,* the latter being crystalline dust or concretions of crystals not showing definite structural arrangement.

The organic matter is usually quite overshadowed by the crystalline deposit. But exceptionally the organic matter (blood clot or fibrin)

predominates.[1] The stone still shows laminae, and salts (usually calcium phosphate), but has the consistency of soft rubber. Such stones (called fibrinous, colloid or blood calculi) are intermediary in type between the familiar hard calculus and the unorganized masses of crystals and fibrin sometimes found.

The *nucleus* of a stone may consist of whatever, among the organized, crystalline, or earthy constituents of normal or pathological urine, is capable of concreting into a more or less solid mass; or it may be a foreign substance either coming from within the body or introduced from without. The nucleus is usually in the center of the stone (Figs. 72, 73). An unusual excentric development is shown in Fig. 71.

The calculus takes its distinguishing title from the salt or salts which enter chiefly into its composition.

VARIETIES

The more refined and obscure points relative to the varieties of stone and their pathogenesis cannot be dwelt upon here. My father consid-

Fig. 73.—Section of Calculus of Mixed Uric Acid and Oxalate of Lime, Coated with Phosphates. Such a stone would pass for phosphatic on inspection.

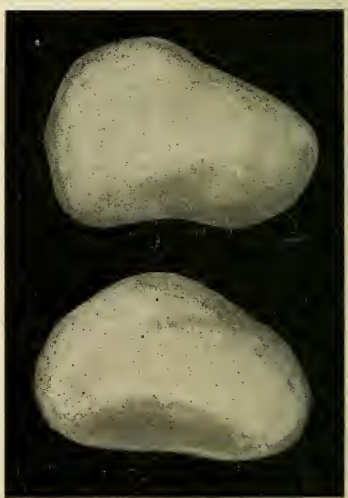


Fig. 74.—Multiple Phosphatic Calculi (Natural Size). The irregular shape is due to friction. (There were six similar stones in t' is case).

ered the subject at length in another place.[2] All stones came under one of the following groups:

[1] Cf. Gage and Beal, *Ann. Surg.*, 1908, xlvii, 378.

[2] *Internat. Encycl. of Surgery* (Ashhurst), vol. vi. p. 145.

Primary stone, which develops in an acid urine without any antecedent inflammation, may consist of uric acid, urate of soda, lime, or potash, oxalate of lime, cystin, xanthin, carbonate of lime, crystalline phosphate of lime, or indigo.

Secondary stone, which develops in an alkaline urine as the result of inflammation, may consist of ammoniomagnesium phosphate (triple phosphate), amorphous phosphate of lime, tricalcic phosphate, urate of ammonia, or urostealith.

Fig. 75.—Oxalate (Mulberry) Calculus.

Among the primary stones only those composed of uric acid, oxalate of lime, and urates are common; the other varieties are extremely rare. Secondary stones are commonly formed of mixed phosphates, very rarely of urate of ammonia or urostealith. Primary calculi are usually formed of the same substance throughout, while secondary phosphatic calculi are often formed about a primary stone as a nucleus.

The *color* of stone is that of its crystals modified by blood pigment. Thus the smooth mucus-covered phosphatic stone remains white, but the rough oxalate stone usually loses its original color and becomes brownish.

The *form* of a stone depends upon various circumstances, as illustrated herewith. If fixed, it takes the shape of the cavity in which it lies. If movable, it is ovoidal. If in contact with another stone it is faceted. Numerous small stones lying in contact are faceted or spheroidal.

Fig. 76.—Multiple Small Phosphatic Calculi (Natural Size) These stones are selected from a group of 33 similar ones. These small stones show sharp faceting from friction.

Uric Acid.—Uric acid stone is found in 80 per cent of all stones. It is usually mixed intimately or in layers with urates and oxalate of lime. Its color varies from a light fawn to a dark brown, in proportion to the admixture of blood and oxalates. When cut and polished it resembles an agate, displaying a concentric arrangement of irregularly curved lines of slightly varying color and thickness (Fig. 73).

The "urate" stone, comparatively light in color and soft in consistency, is composed of a mixture of uric acid and urates. This type of stone is common in the bladder, rare in the kidney and ureter.

Oxalate.—Oxalate of lime stone is commonly single, blackish-brown in color, and very hard. It is usually covered with blunted asperities,

whence it has acquired the name of mulberry calculus (Fig. 75). Upon section it shows undulating laminae, which may vary widely in color, as there is often an admixture of uric acid (Fig. 72).

Phosphate.—Mixed phosphate calculus is the common *secondary* calculus. It may grow to an enormous size, and may be single or multiple (Figs. 73, 74, 76). It forms around a primary calculus, a blood clot, or a foreign body. It is granular, soft, light in weight, and of a dirty white color. It may be amorphous or laminated.

The other forms of calculi are so rare as to require no special mention. Cystinuria has a medical rather than a surgical interest. Xanthin [1] is even rarer. I have removed one cystin and one uric acid and xanthin calculus.

ETIOLOGY

The causes of stone formation are extremely obscure. Secondary (phosphatic) stones are known to result from the changes in the urine commonly known as alkaline fermentation. Such calculi are frequent in old men suffering from the cystitis of prostatism, and are less frequently met with as the result of other forms of inflammation.

But the etiology of primary calculus is most obscure. Primary stones are very uncommon in women. The negro is said to be singularly exempt, and there are two periods of life during which they are most frequently found—viz., in the first two and in the fifth decades of life. But the most notable feature of the occurrence of primary stone is its great frequency in certain localities and its comparative rarity in others. Thus India leads the list with hundreds of operations a year. Egypt perhaps, comes second, and North America is, as a whole, comparatively exempt. Yet in certain parts of India primary calculus is quite as rare as it is with us, and it has also been observed that the tendency to stone among the inhabitants of a certain district seems to increase or decrease regularly over a long period of years. To explain these vagaries various theories have been adduced. The influence of the climate, the soil, the water, the civilization of the inhabitants (as affecting their occupations), the diet, especially the amount of salt habitually taken—all of these and various other factors have been implicated.

There is some evidence of a hereditary tendency to stone formation closely allied to the uric acid diathesis. Indeed, the predisposing cause of primary stone is undoubtedly the presence of crystals in the urine. Without crystals there can be no calculus, yet the urine may contain crystals for years and no stone form. A notable example is the phosphaturia so common in the young. It may continue for years, and the urine may be so thick with phosphates that the terminal drops, if they

[1] *N. Y. Med. Jour.*, Jan. 16, 1915, p. 120.

fall upon the patient's shoe, give the effect of a splash of mortar. Yet phosphatic stone is never due to this phosphaturia. In point of fact, the microscope reveals that a urinary calculus is made up, not of the sharp-pointed crystals so commonly seen in the urine, but of rounded masses, showing neither angles nor polarity, and consisting of an amorphous collection of granules of a urinary salt embedded in a structureless, albuminous substance. If true crystals appear, they occur simply as foreign bodies entrapped in the stone. Rainey and Ord have conclusively shown that the determining cause of calculus is the increased density of the urine and the presence of colloid substances in solution, in conjunction with an excess of urinary salts; for "a crystalloid is deposited from solution in the presence of a colloid," and crystals introduced into a colloidal solution are disintegrated and reformed by simple, molecular coalescence.[1] Thus the nucleus of a stone is always laid down in an albuminous substance. A blood clot, a foreign body surrounded by the mucopus stirred up by its presence, or the mucoid exudate of a mild infection may form this nucleus. And once the nucleus has formed, it is always in such a foreign body surrounded by albuminous matter that new layers of stone are constantly being formed.

The rate of growth of a stone must vary greatly. Thus it is known that phosphatic stones grow, as a rule, much faster than primary ones, and yet my father removed a uric acid calculus weighing 2 ounces from a boy nine years old, and a hairpin from a girl's bladder (in which it had remained for more than a year), which was incrusted with less than a dram of phosphates.

But the practical problem in the etiology of stone is not "Why does stone form?" but "Why is stone retained?" If every stone were passed as soon as it is formed, renal colics would be even more common than they are; but renal calculus would not be a surgical disease. The formation of stone we can do little to prevent. The retention of stone is in large part under our control.

PREVENTIVE AND SOLVENT TREATMENT OF CALCULUS

Inasmuch as the discovery or passage of a single stone suggests the possibility that others may be present or may subsequently form, every case of urinary calculus presents the problem of how to prevent the recurrence of stone, while many patients, moved by the blazon of the Buffalo lithia bottle, inquire, "How shall I dissolve my stone?"

As an elementary proposition, we may state that urinary calculus cannot be dissolved. Unless it is passed it must be removed. Spontaneous fracture will not help matters.

[1] Schade, *Muench. med. Wochenschr.*, Apr. 4, 1911.

But medical aids may very properly be invoked under two conditions:

1. To aid the passage of a small ureteral stone (p. 400).

2. To prevent recurrence of stone after all calculi have been passed or removed.

No treatment can guarantee success in either event, but treatment should be conducted along the following lines:

Secondary Stone.—For the prevention of secondary stone we depend upon the cure or control of the inflammation causing it.

Primary Stone.—The treatment includes:

1. Relief of retention.
2. Dietetics—exercise—encouraging elimination by other avenues.
3. Diluting the urine.
4. Specifics.

1. Relief of Retention.—In the past our attention has been centered upon more or less futile attempts to prevent the formation of stone.[1] The future will see more attention paid to attempts to prevent the retention of stone. For, as stated above, stone formation is of small importance as compared with stone retention. No diet, medicine or mode of life is guaranteed to prevent the re-formation of stone. But good surgery may often guarantee the prompt passage of any stone that does re-form, and may thus solve the problem of the patient's cure.

The details of the relief of retention are dealt with specifically for each type of stone.

2. Hygiene.—Hygiene and mode of life have nothing to do with the cure of phosphatic stone, since this is secondary to infection, nor with the amorphous urate stone for this will inevitably recur in the bladder unless relief is afforded to the retention. Hygiene relates only to the oxalate stones that form in the kidney.

The two great stone forming periods for oxalates are intra-uterine life, and perhaps early infancy, and the years between thirty and fifty. Why oxalate stones should prefer these periods is not quite clear. They might perhaps be called sedentary (though mothers and golfers would deny that). The two factors of the greatest importance are, on the one hand, an excessive nitrogenous intake, and on the other hand, an excretory sluggishness, perhaps an actual retention of urine.

The fetus we cannot reach. But the middle-aged patient begins to have renal colic during the time when he is exchanging tennis for golf or giving up exercise altogether, really settling down to the hard struggle of self-support, or the even sterner struggle for success, is likely to smoke too much, to drink too much whiskey and too little water,

[1] Thus Rosenbloom (*Jour. A. M. A.*, July 10, 1915) observes that though urates are more soluble in alkalies, oxalates are more soluble in an acid medium.

to overeat, to be mildly constipated, perhaps to show indican and a high blood pressure. Such a man requires exercise. Exercise is the use of the muscles in the open air, in an enjoyable fashion, so violently as to cause perspiration. His diet should be low in nitrogen; alcohol, tea, coffee and tobacco should be used sparingly, and his bowels should be kept freely open.

3. Dilution.—The difficulty with all the above restrictions is that they are not for three months, but for twenty years. Unless they are prescribed with a very clear understanding of the patient's personality they are futile. On the other hand, the patient is usually quite willing to return twice a year for urinalysis. Advantage may be taken of this to insist that he drink enough water to keep the specific gravity of the urine down to or below 1.015. So long as this is done the likelihood of stone formation is relatively slight. Patients who have difficulty in keeping the urine thus diluted will be much assisted by an occasional course at a diuretic or cathartic mineral spring. The English, than whom one could not ask for better authority upon such a subject, show a strong preference for Contrexeville and Carlsbad. French Lick in Indiana is of benefit to many persons.

4. Specifics.—Specifics for stone appeal so little to the modern mind that it seems scarcely worth while to enumerate them. Casper [1] advocates the use of glycerin in tablespoonful doses, both to prevent the formation of calculi, and to favor their passage.

[1] *Med. Klin.*, October 6, 1915, ciii, 1611.

CHAPTER XL

RENAL AND URETERAL CALCULUS

Calculi occupying the kidney pelvis or calices are spoken of as renal; those occupying the ureter are called ureteral calculi. All ureteral calculi are actually renal calculi that have slipped down from the pelvis of the kidney and caught in the ureter. A large proportion of vesical calculi originate in the kidney.

Renal calculi are usually single. Exceptionally a great number of stones are found. Thus Morris removed 200 stones from one kidney and Dessirier and Legrand found 400 calculi in the left kidney and 60 in the right at the autopsy of a young soldier who during life had shown no symptoms referable to the kidneys. Renal calculi run up to about 100 grams (3 ounces)[1] in weight, the large stones being irregularly branched to fit into the distorted and dilated pelvis and calices (Figs. 33, 34, 35 and 77). In operating upon a suppurating or tuberculous kidney one occasionally meets with very small stones, scarcely more than phosphatic grit. Fibrinous calculi are also sometimes encountered.

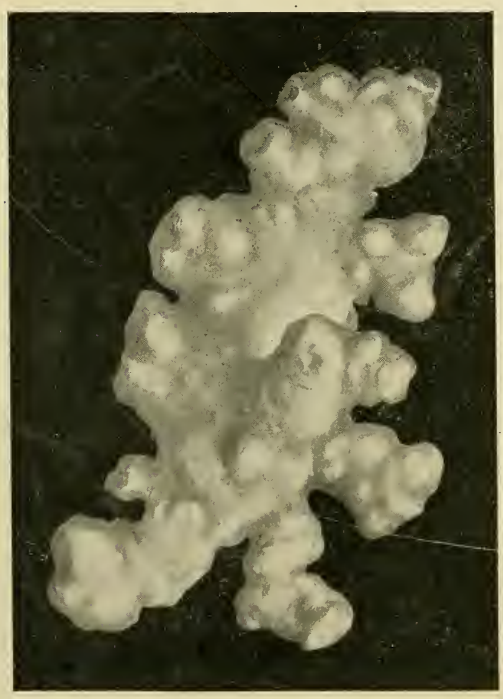


Fig. 77.—Large Branched Renal Calculus.

Kraft found renal calculi 40 times in 2,953 autopsies; both kidneys were affected 15 times. Legueu and Albarran agree that in about half the cases both kidneys contain calculi, yet recent x-ray investigations go to show that in the living the proportion of bilateral cases is not so great.

[1] Watson and Cunningham depict a calculus that weighed one and a half pounds.

Ureteral calculi are ovoidal in shape. If multiple and in contact they are faceted, but they are almost always elongated in one diameter and therefore *do not throw a round shadow* under the Röntgen ray, a fact of great importance in the study of such shadows (Pl. IV).

Ureteral stones are usually unilateral, single, ovoidal, small. Most exceptional are such stones as those removed by Fedoroff (length 19 cm., wt. 52 gm.), Bloch (length 13 cm., wt. 54 gm.), and Jacobs (length 7.5 cm., wt. 44 gm.).

The relative frequency of renal and ureteral calculi is still a question for dispute. In the preradiographic period the preponderance of renal over ureteral calculi was notable. Today the radiographer finds most calculi in the ureter. Thus Leonard[1] found calculi 36 times in the renal pelvis against 70 times in the ureter.

The x-ray catches the stone in transit, as it were, for all renal and ureteral stones originate in the renal pelvis, and of those seen by the radiographer in the ureter the greater number (31 out of Leonard's 46 cases) are passed spontaneously.

The points in the ureter where a calculus is most likely to be caught are (with percentages given by Jeanbran):[2]

1. One to two cm. below the renal pelvis (46 per cent).
2. At the lower end of the ureter, within its ultimate 10 cm. (51 per cent), less often in its course through the bladder wall (17 per cent).
3. Rarely at or above the pelvic brim (15 per cent).

PATHOLOGY

The changes that occur in the kidneys and ureters from the presence of calculi may be considered under three heads—viz., retention, ulceration, and inflammation.

Retention.—A calculus formed in the renal pelvis may at any moment slip down and be caught at the orifice of the ureter, or at any physiological or pathological narrowing in that duct. Such an impaction may be partial or complete. It is usually partial, and as the urine dammed up behind this sudden obstacle brings pressure upon it, the stone is forcibly driven into the ureter, setting up a *renal colic.* This is relieved by the passage of the stone into the bladder, by its slipping back into the pelvis, or by the gradual accommodation of the parts to the new conditions. If the stone remains impacted it causes either partial retention resulting in *hydronephrosis,* or complete retention resulting in an acute anuria and subsequent atrophy of the kidney (unless the ob-

[1] *Jour. Am. Med. Assn.,* 1907, xlix, 1094, and *ibid.,* 1909, lii, 289.

[2] *Trans. French Urol. Assn.,* 1909, xiii.

struction is relieved). This complete retention is evinced by *anuria*—calculous anuria it is called—which is partial or temporary if the opposite kidney is able to continue its functions, permanent and fatal if the opposite kidney stops secreting, whether on account of reflex congestion or of bilateral calculous obstruction.

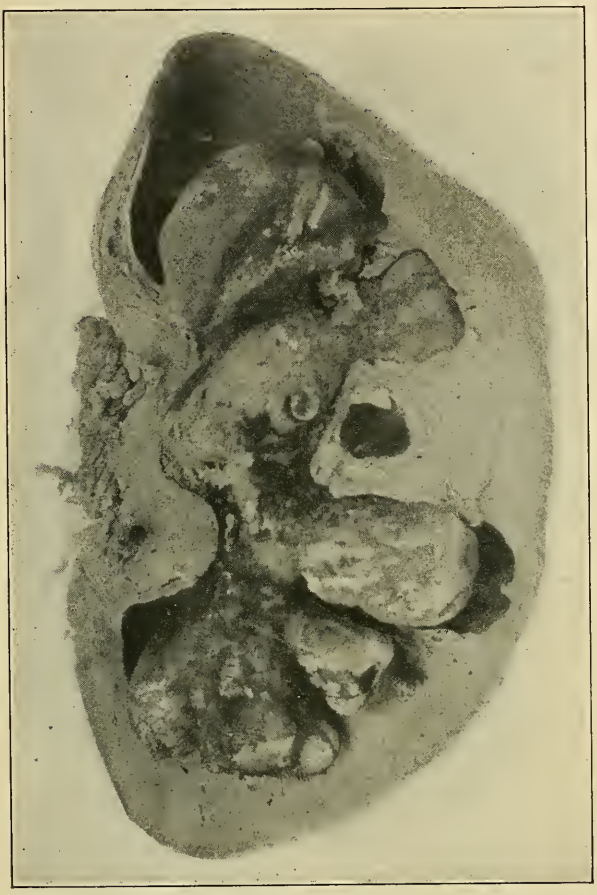


Fig. 78.—Kidney Destroyed by Large Branching Silent Calculus. The patient had pus, frequency and tubercle bacilli. Nephrectomy for tuberculosis revealed this stone and a few minute tuberculous lesions.

Ulceration.—Ulceration occurs at whatever point in the kidney, the pelvis, or the ureter a stone may rest. If the stone is small and movable the ulceration may be insignificant. If it is large or impacted, the ulceration may be so deep and extensive that actual *perforation* occurs, permitting the stone to escape from the kidney (the pelvis or the ureter) into the surrounding tissues. This complication, associated as it is with urinary extravasation, is as unusual as it is grave. *Ureteral stricture* results from calculous impaction.

Inflammation.—It is futile to attempt to enumerate the various lesions that may be caused by one or more stones in the various portions of the upper urinary tract. The lesions of retention, ulceration, and inflammation are combined in endless variety. There may be only localized suppuration about a small pelvic calculus, or there may be numerous calculous pockets throughout the kidney; the entire organ may be reduced to a multilocular abscess cavity filled by a great branching stone (Fig. 78). The kidney may be found atrophied, and closely contracted around a stone that had caused complete obstruc-

tion years before. Pyonephrosis results from obstruction of the ureter by stone or stricture when there is infection. Suppuration within the organ may be associated with *perinephritis* from extension of the inflammation or from rupture of the sac. The ureter shows various degrees of dilatation, ureteritis and periureteritis. The longer the disease continues the more extensive the destruction of renal tissue and the greater the likelihood of bilateral calculous disease.

The Ureter.—The relations of stone and ureter are four, viz.:

1. The stone is simply in transit. It may catch from time to time, causing renal colic and perhaps slight temporary ureteritis and dilatation; but ultimately passes and leaves no permanent change in the canal.

2. The stone is definitely arrested. The ureter above it is dilated, about it ulcerated, below it strictured. The stone may be relatively movable (at operation) or fixed. As it grows it may become encysted in a pocket in the ureter wall.

3. The ureter ruptures (a) by acute gangrene, or (b) ulceration about an encysted stone. The result is usually acute retroperitoneal phlegmon, infiltration of urine, abscess, fistula. Rarely an encysted stone escapes silently into the retroperitoneal tissue.[1]

4. The ureter is so dilated, the stone so smooth and small, that the latter slips readily to and from the pelvis, up and down the ureter.

Carcinoma.—I have seen two cases of renal carcinoma secondary to stone. Coryell [2] reports nine such cases.

Tuberculosis.—See Fig. 78.

SYMPTOMS

Renal calculus may exist for years without causing any symptoms whatever. Morris mentions the notable symptoms caused by renal calculus in 103 cases of his own. These he tabulates as follows:

Pain occurred in	71 cases	(69 per cent).
Pyuria occurred in	50 "	(48 per cent).
Renal colic occurred in	44 "	(43 per cent).
Hematuria occurred in	41 "	(40 per cent).
Kidney palpably enlarged in	27 "	(26 per cent).
Troubles of micturition occurred in..	24 "	(23 per cent).

Pain.—Of calculous diseases, Morris writes: "They are the most frequent and most painful of surgical diseases of the kidney. Probably

[1] Cf. Frenkel, *Guyon's Annales*, xxix, p. 1825.

[2] *Bull. J. Hopkins Hospital*, April, 1915, xxvi, 93.

no disease, except acute tetanus, is capable of causing worse suffering." The various pains due to renal and ureteral calculi are renal colic, pressure pains, and reflex pains.

Renal Colic.—This is the most characteristic symptom of stone in the kidney. It is due to the impaction of a stone in the ureter. The pain is paroxysmal in character. It commences suddenly in the loin or side, at any time, when the patient is seemingly in the best of health. It shoots down the ureter into the scrotum and to the end of the penis. The testicle of the affected side is often strongly retracted. Indeed, the entire scrotum and penis may be drawn up into a hard knot, as it were. The pain may also extend down the thigh on the affected side. There may be an incessant desire to pass water. What little urine is voided comes away high-colored and tinged with blood. If the paroxysm is severe, faintness, nausea, and vomiting occur, the skin is covered with a cold sweat, and the patient passes into severe shock.

In the intervals between paroxysms there is a sense of soreness and discomfort perhaps amounting to continued pain, or the relief may be absolute. After one or more paroxysms, lasting from a few hours to many days, all pain suddenly ceases. This sudden cessation indicates that the stone has been liberated. It may have fallen back into the pelvis of the kidney, have passed down into the bladder, or have reached some dilated portion of the ureter, where it rests without interrupting the urinary outflow.

If the impaction has occurred at the upper end of the ureter and is relieved by the stone slipping back into the pelvis, the pain during the attack is usually most intense in the loin and radiates across the back rather than down the ureter. On the other hand, if the stone travels down the ureter to the bladder, its descent is often marked by a progression of the pain from the loin to the pelvis—interrupted by periods of relative or absolute ease—with a corresponding increase in the vesical irritability and the pain and retraction of the testicle. But this relation of the pain to the progress of the stone has many exceptions.

Pressure Pains.—When the stone is in such a position or of such a size as to fill the cavity in which it lies, it may cause a dull continuous ache associated with tenderness. This ache is rarely severe; indeed, some persons will endure it for years without attaching any great importance to it.

Reflex Pains.—The two most notable renal reflex pains excited by stone are: (1) Pain following the course of the ureter into the pelvis and thence radiating to the testicle and thigh, and (2) painful and frequent urination.

I have twice seen frequent and painful urination as the only symp-

tom of a stone filling the renal pelvis. But this symptom usually means irritation (stone) at the lower end of the ureter.

The pain may occasionally be felt only in the "stomach" and associated with vomiting. Or it may be "sacro-iliac" or "lumbago" in type.

It is questionable whether stone in one kidney may give pain referred only to the opposite organ. This so-called "renorenal reflex" is usually due to hypertrophy or disease of the opposite kidney.

Hematuria.—As shown by the table, considerable hematuria is a fairly constant symptom of stone. Yet it is variable to the last degree. Some hematuria usually accompanies and follows a renal colic, and in most cases there is a fairly constant oozing of blood, showing itself only by the presence of a few red cells and a trace of albumin in the urine. Blood casts and long ureteral clots rarely occur. The bleeding is usually made worse by exercise (though the pain is not), and hence the presence of a great number of red cells in the sediment centrifuged from the urine passed after exercise is suggestive of stone. But, after all, the hemorrhage caused by renal stone is an inconstant symptom. It may be entirely absent even after a renal colic.

The remaining symptoms on the list require no special notice.

COURSE OF THE DISEASE

The course of the disease is entirely irregular. The character of the symptoms bears no precise relation to the size or position of the stone; and the progress of the disease varies from the cases that have only a single fatal attack of calculous anuria or that die of some intercurrent disease without ever having manifested any symptom referable to the calculi with which their kidneys are filled to those that drag on for years with chronic renal suppuration and repeated passage of stone.

Several types of the disease may be mentioned, due allowance being made for the fact that a given case is often a compound of several types. The surgeon encounters: (1) Cases without symptoms, (2) cases of renal colic, (3) cases of calculous anuria, (4) cases of renal distention, and (5) cases of renal suppuration.

Cases Without Symptoms.—The onset of symptoms of renal calculus is not the beginning of stone. When the minute calculus first forms in the renal pelvis its place is determined by the shape and drainage of that cavity. If the pelvis is well drained the urinary stream will sweep the little calculus into the ureter before it has attained any great size. It announces its passage to the bladder by a series of renal colics, even though it be extremely minute, no larger than a grain of wheat.

But if the pelvis is not well drained a stone naturally sinks into some calyx where it slowly and silently grows. At most it causes a pyuria, or a microscopic hematuria. But since this excites no subjective symptoms it is usually entirely overlooked. Such stone, if actually silent, may be discovered only at autopsy or by the investigation that follows the disclosure of albumin and pus in the urine as the result of an examination for life insurance. Such stones frequently grow quite silently until the kidney is almost totally destroyed and the x-ray shows an enormous stone (Pl. VI). Although it is possible for stone, even bilateral renal stone, to remain thus silent for twenty or thirty years or longer. At the onset, or at least during the first five or ten years of the disease, small pieces of stone are likely to descend into the bladder, giving a history either of renal colic or of vesical calculus. Later in the disease the stone may cause slight, painless, protracted hematuria. It is very likely to cause some disturbance of urination, and perhaps excite a great deal of bladder irritability, and when large it always causes pyuria, albuminuria and diminution of the kidney function. If all of these symptoms are either overlooked or misinterpreted the patient may be left to die of renal insufficiency alone or excited by some intercurrent disease or accident (Fig. 78; also Pl. VI).

Renal Colic.—The preceding description of the general character of the attack of renal colic leaves only a few remarks to be made upon this subject. The course usually lasts only three or four months if the stone is to pass. But I have several times known a stone to pass from the ureter after two years of colics. Yet even when the stone has passed, the stone-forming habit is likely to continue, so that either from the discharge of calculi collected in the kidney pelves above, or from the actual formation of new stones, the patient who has once had renal colics is rather likely to have further attacks in later years. In one sense, however, renal colic with the passage of stone, and no evidence of any deterioration of kidney function or accumulation of stone left behind in the kidney pelvis, is a good omen, for it means that the kidney pelvis drains well, and that if subsequent stones do form they are likely to be passed as was the first one.

Reflex Symptoms.—Other cases again give only reflex symptoms. One of my earliest professional recollections is of an old man who for years suffered only from painful and frequent urination. His bladder was washed, searched, sounded, and even cut—all to no avail. New York's best surgeons of those days could do nothing for him. Finally, his protracted agony was terminated by a fatal attack of suppression of urine, as it was called. Autopsy revealed a normal bladder and one kidney atrophied and tightly contracted about a calculus, the other somewhat dilated and with a stone plugging the ureteral orifice. Yet he had never complained of a symptom referable to either kidney.

Calculous Anuria.—Calculous anuria is a stoppage of the urinary flow caused by the plugging of one or both ureters with calculi. It is part suppression, part retention. The terminal anuria in the case mentioned above was a pure retention. One kidney had been out of commission for years; the flow of urine from the other was stopped by the obstructing stone. In other cases the blockage of one ureter throws such a burden of excretion upon the opposite kidney that it becomes acutely congested, and suppression ensues. Thus anuria may ensue (1) when both ureters are completely obstructed, or (2) when one ureter is obstructed and the opposite kidney absent, hypertrophied, or sufficiently diseased to be incapable of enduring the congestion forced upon it. The acute obstruction is clinically unilateral, but unless both kidneys are diseased anuria does not occur.

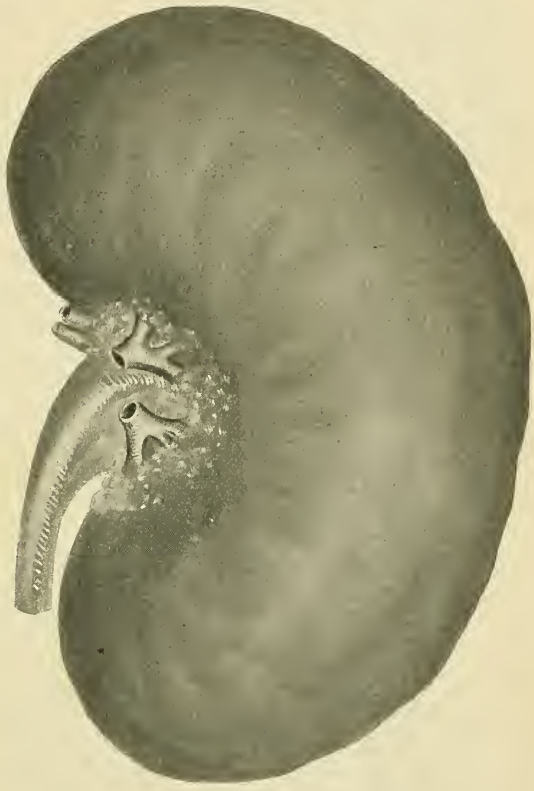


Fig. 79.—Calculous Anuria; the Congested Kidney. The stone was impacted lower down the ureter. (Compare Fig. 80.)

Pathology. — The pathology of calculous anuria is striking and characteristic. The obstructed kidney, which may be hydronephrotic or suppurating, is intensely congested. It is enlarged to twice or thrice its normal size and is dark in color. On section its tissues are found friable and edematous. Such a large, soft purple organ once seen is never forgotten (Fig. 79).

The opposite kidney in all but 3 of the 58 cases collected by Morris was absent or completely disorganized.

Symptoms.—The symptoms of calculous anuria may be divided into three stages: 1. The premonitory stage. 2. The tolerant stage. 3. The uremic stage.

1. In the *premonitory stage* there is more or less pain, perhaps an

actual colic, referred to the kidney. It persists from a few hours to a few days.

FIG. 80.—CALCULOUS HYDRONEPHROSIS. A small stone was found lodged at A. This kidney is the fellow of the one shown in Fig. 79. They were obtained from a patient who died of calculous anuria.

2. The *tolerant stage* is characterized by but one symptom—viz., anuria. The patient does not pass water. This anuria is rarely absolute. A few grams of urine tinged with blood are passed every day, or perhaps the anuria runs a remittent course. At one time or another 2 or 3 liters of urine may gush forth, a misleading promise of relief, for the flow is but temporary. This state of affairs lasts from three days to a week. *Not a drop of urine may be passed during several days and yet the patient may, apparently, remain in the best of health.* No more striking contrast could well be imagined than that presented by calculous anuria: on the one hand, the grave renal lesion, the absolute retention, the swift fulminating character of the uremic period soon to follow; and, on the other hand, this entire absence of symptoms, local or general. The patient goes about well content. He eats, sleeps, and works pretty much as usual. Whatever pain he has had in the loin is past, and his present discomforts are insignificant. Yet all the while there is brewing within him a crisis swift and terrible.

FIG. 81.—CALCULOUS PYONEPHROSIS. This kidney contained the stone shown in Fig. 77.

Spontaneous recovery may occur. The obstruction is relieved; the urine gushes out, 3 or 4 liters a day, and all is well. This may occur in 20.8 per cent (Morris) to 28.5 per cent (Legueu) of cases. In Legueu's [1] cases the spontaneous cure took place

[1] *Guyon's Annales*, 1895, xiii, 865.

on the third day once, between the fifth and the tenth day twice; later still in five instances. Yet it is obvious that one should not await spontaneous cure.

When spontaneous recovery does not occur the patient passes into the third stage of the disease at the end of a week or ten days.

3. The *uremic stage* is usually ushered in by hiccough or vomiting. This is the first warning. It may continue for a day or two without additional symptoms. The pulse is tense, the temperature usually subnormal. Constipation becomes absolute and the intestines are distended with gas. The vomiting grows more severe, the intellect becomes

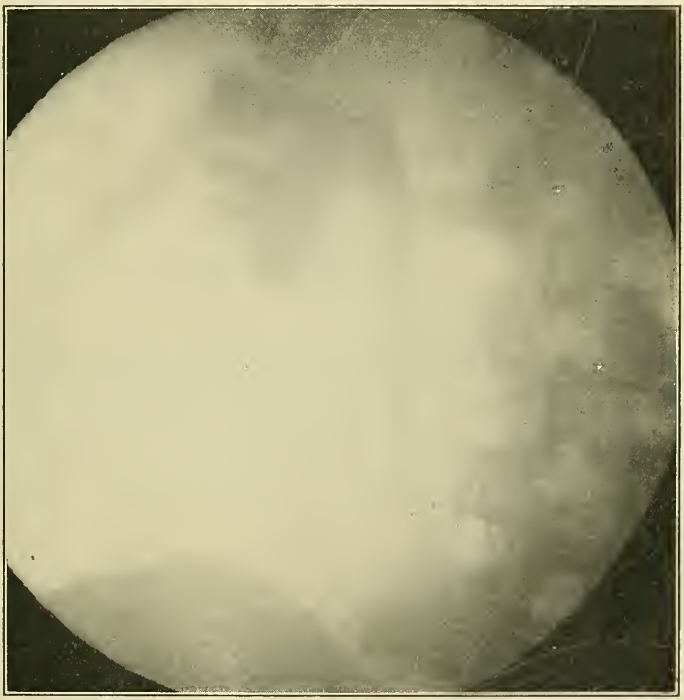


FIG. 82.—PYELOGRAM SHOWING DILATED KIDNEY AND URETER (PYELONEPHRITIS) AFTER REMOVAL OF STONE.

dulled and stuporous. The patient's mind may wander a little, and he may even have maniacal attacks. Thus he sinks away and dies, usually within two or three days of the first hiccough or vomiting.

Such is the clinical picture of what Morris has aptly termed the gravest and most fatal of the many serious complications of urinary lithiasis. Of course there are atypical cases: the obstruction may be intermittent or partial; but such cases require no special notice.

Calculous Hydronephrosis.—Calculous hydronephrosis is due to the

impaction of a stone in the ureter (Fig. 80), or rarely to a stricture secondary to calculous ulceration. The development of the hydronephrosis is habitually marked by a series of renal colics, and hydronephrosis may be one of the features of calculous anuria. The symptoms and signs of hydronephrosis are detailed elsewhere.

Renal Suppuration.—Stone in the kidney is one of the most common causes of pyelonephritis. It also causes pyonephrosis (Fig. 81); while secondary phosphatic calculus or phosphatic deposit upon a pre-existing calculus results from the inflammation.

The variations imprinted upon the classical picture of pyelonephritis and pyonephrosis by the presence of stone are few. There are the same urinary septicemia, the same local symptoms. There may be colic. Hemorrhages occur from time to time. The inflammation is rarely acute or virulent, but progresses slowly, terminating finally in pyonephrosis or perinephritic abscess.

DIAGNOSIS

The accurate diagnosis of stone in the kidney pelvis or the ureter must cover the following points:

1. The presence or absence of stone.
2. The number, position, and distribution of stones.
3. The presence or absence of renal infection.
4. The functional capacity of both kidneys.

In order to make this diagnosis, familiarity with radiography and with the methods of testing the renal function is essential. Without the x-ray and the ureter catheter it is possible, in certain cases, to diagnose the presence of stone with some accuracy and to operate for its relief with some success; but both methods are necessary in order to insure good work in all cases, and in order to insure any diagnosis at all in some.

The most typical history of renal stone, even if accompanied by characteristic gross evidences of such conditions as pyonephrosis or calculous anuria, is not enough to indicate to the surgeon such important facts as the position and number of the stones present, or the functional capacity of the opposite kidney; and most cases first apply for relief at a time when the history is anything but characteristic, the physical signs anything but adequate to insure appropriate treatment.

The following table, which has been prepared by Dr. Charles Eastmond as a result of his radiographic experiences, indicates quite accurately how often the symptoms and physical signs are misleading as to the presence or absence of stone. They are still more often misleading as to the condition of the kidneys.

TOTAL CASES, 80 { Calculus present....23 = (28.75%) / Negative.....57 = (71.25%)

23 cases of calculi:
- With typical symptoms (renal) 8
  (Two had additional calculi in opposite kidney.)
- With indefinite symptoms..... 9
- With symptoms on opposite side to calculus 3
- With symptoms referred to other parts..... 3
  (Of these, two had renal symptoms with calculi in the bladder; one vesical symptoms with calculus in kidney.)

58 with typical symptoms { calculi.....14 = (24.14%) / calculi in suspected region..... 8 = (13.79%)

22 with indefinite symptoms—calculi..... 9 = (40.90%)

URINE.

			Pus.	*Blood.*	*Both.*	*None.*	*Total.*	
23 with calculus	Typical symptoms with calculi	+ sand[1]	1	1	1	1	4	8 = (34.78%)
		0 sand	1	2	0	1	4	
	Symptoms vague or referred to other points than site of calculus	+ sand	2	1	2	0	5	15 = (65.22%)
		0 sand	5	1	0	4	10	
			9	5	3	6		
57 negative	Typical symptoms—O calculi	+ sand	3	6	4	5	18	44 = (77.19%)
		0 sand	5	4	8	9	26	
	Vague symptoms—O calculi	+ sand	0	3	0	6	9	13
		0 sand	1	1	2	0	4	
			18	19	17	26	80	

Our means of diagnosis may be summed up under the following heads, in the order of their employment:

1. The patient's history.
2. Physical examination and urinalysis.
3. Radiography.
4. Substitutes for radiography.
5. Ureteral catheterism.
6. Exploratory operation.

Patient's History.—The presence of calculus is suggested by history of the passage of stone, of renal colic, of anuria, or by the presence or history of stone in the bladder. Every case of pyelonephritis is suspected to be calculous until the absence of calculus has been proven by radiography. Yet how misleading the history may be is shown by the table given above.

Physical Examination and Urinalysis.—The presence of stone in the bladder or of renal infection suggests the possibility of renal or ureteral stone. It is exceptionally possible to palpate through the vagina or the rectum large stones incarcerated at the lower end of the ureter.

Urinalysis suggests stone when crystals of uric acid or oxalate of lime are present in great numbers, especially if these are found in the

[1] History or present evidence of the passage of stone, gravel, sand, or crystals.

rounded forms. A relatively high percentage of urea in relation to the urinary specific gravity is suggestive of stone, and the presence of blood cells with crystals in the urine is peculiarly suggestive. Yet the passage of crystals alone often causes renal colic and may even produce a macroscopic hemorrhage. Moreover, while the rule is almost universal that, so long as stone is present in the upper urinary tract, there are constantly a few blood cells in the urine, I have known two notable exceptions to this rule: i. e., two cases in which stone was present but the urine showed no red blood cells. On the other hand, microscopic traces of blood are constantly found in the urine as a result of so many conditions other than renal stone that the presence of blood cells alone is no more than suggestive.

Appendicitis and ureter stone give symptoms so closely simulating each other that special signs, notably blood and pus in the urine, have been sought to distinguish them. But appendicitis can cause hematuria through involvement of the lower ureter in the inflammation, or by causing toxic or bacterial nephritis.[1]

The presence of tubercle bacilli in the urine does not exclude stone, for secondary stone may form in a tuberculous kidney.

Radiography.—A good radiograph is the surest evidence in the diagnosis of renal and ureteral stone. (Figs. 30 to 35; Pl. III to VIII). For it shows the size, shape and disposition of calculi. But an x-ray plate is by no means infallible. It may fail to show a stone, even though the plate be perfect. And it may show shadows suggestive of stone when no stone is actually present. Real familiarity with radiography is required for the interpretation of plates. A few of the elementary requisites are detailed in Chapter IX, but this real familiarity can only be gained by long experience.

The greatest check on the accuracy of radiography is to be sought in the evidence of renal insufficiency and infection which always results from the presence of large stones, and the wax-tipped catheter which confirms the presence of small ones.

The Wax-tipped Catheter.—The wax-tipped catheter devised by Kelly consists of a ureter catheter, the tip of which has been dipped in melted dentist's wax. This tip should be carefully examined with a magnifying glass before the instrument is introduced, to be sure it is not scratched.

Several ingenious devices have been suggested whereby the wax-tipped catheter may be introduced through the indirect vision cystoscope without scratching the wax. The simplest of these is a suggestion of Harris that the instrument be introduced first into the bladder, and the cystoscope threaded over this.[2]

[1] Von Frisch, *Zeitschr. f. Urol.*, 1912, Supplement.

[2] *Surg., Gyn. & Obstet.*, December, 1912, p. 727.

His description may be paraphrased, with slight modifications, as follows:

A filiform ureteral bougie or ureteral catheter no larger than No. 4 size is tipped with wax, the drop of wax being about a No. 6 or 8 F. size (if this will not enter the ureter orifice a wax spindle of about the same size may be made at 2 or 3 c.c. from the tip of the filiform). The wax is carefully examined with a magnifying glass for scratches, the filiform is then lubricated, and introduced into the bladder, which has been previously filled with fluid. The distal end of the filiform is then threaded through the catheter sheath, and the cystoscope is guided over it into the bladder just as a tunnelled sound is guided through the urethra. When the cystoscope is introduced it is revolved in the bladder until the shaft of the filiform is seen lying fairly in front of the lens. The deflector is then raised so as to fix it in this position, and the filiform slowly and cautiously withdrawn until the wax bulb is seen in the field. The deflector is then lowered, and the wax again inspected so as to make sure it is not scratched. It is then introduced into the ureter, withdrawn, and inspected while still in the bladder; the bulb being revolved so that all sides are seen. The wax tip, when lying close against the objective of the cystoscope, is so much magnified that there seems no need to withdraw it for examination. If it is found not to be scratched, it may be introduced into the opposite ureter, and the examination repeated. The absence of scratches may be verified still further by turning the lens upward in the distended bladder, pushing the filiform about 5 or 10 c.c. into the bladder, and then gently withdrawing filiform and telescope as one piece. Theoretically, the passage of the wax tip through the open eye of the sheath might result in a scratch; but I have never known this to happen, and the advantage of making the examination in this way is that the wax-tipped bougie may then be withdrawn from the telescope, and set aside for confirmatory examination. The telescope is then reintroduced armed with ureter catheters whereby both ureters may be catheterized, and specimens obtained for estimating the infection and the impairment of function of each kidney.

Hinman has further perfected this method by using a wax-tipped catheter in an operating cystoscope, protecting it with a rubber tube with which it is introduced into the sheath of the instrument. I have not employed this technic.

It has been still further suggested that several bulbs be put upon the catheter so that if this is introduced a known distance into the ureter the scratches on the several bulbs will indicate the position of the stone in the ureter. This technic implies a precision of manipulation which is possessed by but few operators and a fixity in the ureter not characteristic of all stones.

Geraghty and Hinman [1] failed to show the stone by radiography in 15 out of 67 cases of ureter calculus: 7 of these were subsequently passed, 6 others were diagnosed by the wax-tipped catheter, and 2 by operation.

But even the wax-tipped catheter is not infallible. I have not used it often enough to show any reliable statistics, but I have several times failed to identify the presence of small ureteral calculi by its use.

Pyelography.—When simple radiography fails, the wax-tipped catheter affords the most accurate means of diagnosis of those small calculi that are simply in transit through the ureter, or have only recently been obstructed therein. Larger stones, and stones that have remained long enough in the ureter to cause dilatation of this duct, are best diagnosed by means of pyelography. Plate IV illustrates how accurately the injected fluid outlines the dilatation of the ureter about the stone itself, and the dilatation of the duct above it. Such a picture, confirmed by appropriate evidences of impaired renal function and infection, constitutes a definite diagnosis.

A satisfactory injection may often be made even when the catheter will scarcely enter the lower end of the ureter, for if this grasps the ureter catheter tightly the fluid slowly injected will mount the channel in sufficient density to give a good picture.

Ureter Catheter Diagnosis.—The wax-tipped catheter and pyelography are rather accessories to the x-ray diagnosis of renal and ureteral stone. Moreover the cystoscope may reveal bulging or inflammation of the intramural portion of the ureter due to the presence of stone. A stone may be seen projecting from the ureter mouth, or it may be recognized by impact upon the ureter catheter introduced into that channel (though it is usually quite impossible to distinguish the obstruction due to stone from that due to any other cause).

The visible ureter catheter is also essential to the diagnosis of stone in the lower ureter, and described in Chapter IX.

The primary function of the ureter catheter is the study of renal physiology rather than the study of renal pathological anatomy. The diagnosis of renal and ureteral stone is not complete without catheterization of the ureters for the purpose of studying the renal function and the presence or absence of inflammation of the kidneys. Though the results obtained vary beyond the scope of any tabulation we may attempt to classify them loosely as follows:

The impairment of kidney function by even a series of renal colics may be singularly slight. For a few hours after the colic the phenolsulphonephthalein output may be extremely low, but it may then return to normal. The urine obtained by ureter catheter after a renal colic is likely to show red blood cells, and may show pus. But the presence

[1] *Surg., Gyn. & Obstet.*, May, 1915, xx, 515.

of red blood cells must be disregarded on account of the possibility of their having been due to a scratch from the catheter.

On the other hand, chronic pyelonephritis due to stone is usually bilateral even though the stone be unilateral, and the opposite kidney usually shows considerable impairment of its function.

Exploratory Operation.—Calculous anuria, and rupture of the ureter are the only two conditions that so immediately require operation for simple drainage as to warrant the neglect of a preceding ureter catheterization. But if the facilities are at hand, a preliminary ureter catheterization is desirable even in these conditions. (Other conditions due to stone may all be diagnosed by the methods described.)

The exploration under such conditions should consist in drainage of one or both kidney pelves to save the patient's life. Search for the stones should be deferred to a calmer moment.

DIFFERENTIAL DIAGNOSIS

So varied is the symptomatology of renal calculus that it is often overlooked entirely, and more often mistaken for some other malady.

It must be distinguished from other causes of abdominal pain and colic both within (passage of crystals, pyonephrosis, tuberculosis, hydronephrosis) and without the urinary tract (appendicitis, cholecystitis, vesiculitis, pancreatitis, oöphoritis). It is furthermore to be distinguished from such causes of hematuria as nephritis, renal or vesical neoplasm, or tuberculosis, etc., and such causes of anuria as hysteria.

It were a waste of words to assemble in contrast here the various signs that distinguish these diseases.

Let us dwell only upon three important points, viz.:

1. The possibility of "renal" colic without stone.
2. Differentiation between stone and appendicitis.
3. Differentiation of calculous anuria.

Pseudorenal Colic.—I have reported several cases[1] in which the passage of crystals or blood clots from the kidney, intestinal colic, and vesiculitis precisely resembled renal colic in their subjective symptoms. Biliary and appendicular colic and Dietl's crises also simulate true renal colic. Many physicians cherish the delusion that such pseudorenal colics are not as intense as the colics due to stone and do not, for example, require morphin. But in intensity there seems little choice between them. The diagnosis must be made by the x-ray and ureter catheter and with little regard to the intensity of the paroxysm.

Stone and Appendicitis.—Ureteral stone, arrested at or near the pelvic brim, is only one of many conditions which is frequently mis-

[1] *Trans. Am. Assn. Gen.-Urin. Surg.*, 1906, vol. i.

taken for appendicitis. Conversely, the inflamed appendix may not only excite hematuria [1] from toxic nephritis (nephrite toxique appendiculaire of Dieulafoy), bacterial nephritis or involvement of the ureter in the inflammatory process; it may also excite any of the subjective symptoms [2] (such as renal colic, frequent and painful urination and lumbar tenderness) that pertain to these conditions.

Doubtful cases must be submitted to every technical examination, i. e., functional tests, radiography, wax-tipped catheter, and pyelography, before being explored surgically.

Diagnosis of Calculous Anuria.—Anuria may be due to many causes. The terminal anuria of nephritis (whether calculous or not) and the acute anuria of toxic nephritis are accompanied by other grave symptoms that distinguish them plainly from calculous anuria. But hysterical anuria may be quite confusing. Thus Gordon [3] has reported a case of hysterical anuria lasting two days and cured by suggestion, while Grenier [4] saw a hysterical young woman through five attacks of anuria lasting respectively two, four, six, eight, and fifteen days. Papin [5] cites five cases to show that anuria may be the initial symptom of cancer of the rectum. I have seen anuria as a result of nephroptosis.

TREATMENT

Prophylactic Treatment.—See p. 379.

Palliative and Symptomatic Treatment.—The patient suffering from renal calculus may require palliative treatment under the following conditions:

1. During an attack of renal colic.
2. During a period of quiescence.

Treatment of Renal Colic.—Renal colic calls for the relief of pain, not only as a means of alleviating suffering, but also for the purpose of relaxing the ureteral spasm about the stone, and expediting its passage into the bladder. Morphin should be given subcutaneously with a generous hand, and the patient put to bed and swathed in hot blankets if the attack is severe. Sometimes a colon irrigation seems to help to dislodge the stone.

If the attack continues the ureters should be catheterized, and glycerin injected in the hope of relaxing the ureteral spasm.

Severe pain may require general anesthesia for its relief.

[1] Seelig, *Ann. Surg.*, 1908, xlviii, 388.
[2] De Meo, *Guyon's Annales*, 1910, xxviii, 2115.
[3] *Med. Rec.*, 1900, lviii, 289.
[4] *Jour. de méd. de Bordeaux*, 1902, xxxiv.
[5] *Rev. de Gyn.*, 1908, xii.

At the earliest possible opportunity an x-ray should be obtained, since the need of operation may suddenly arise. The persistence of a swollen and tender kidney after the colic has ceased is suggestive evidence of the fact that the ureter remains occluded. Therefore, if the kidney remains tender the ureters should be catheterized to determine whether the ureter is occluded. If so, the case should be treated as one of anuria, and instant operation urged.

But if the colic passes without leaving any tenderness or swelling in the kidney or any evidence of acute renal infection, the patient should nevertheless submit to thorough x-ray examination and cystoscopy with the use of the wax-tipped catheter and of injection for the purpose of diagnosing the situation of the stone and hastening its passage into the bladder.

Treatment of Calculous Anuria.—As soon as calculous anuria is diagnosed, i. e., as soon as it is known that there is anuria, and that the anuria is due to calculus, operation should be performed. Delay is inexcusable except for the purpose of making the diagnosis more accurate. If the patient is seen in the first day or two of the anuria, he should be x-rayed for the purpose of locating the stone, and an attempt should be made by the passage of ureter catheters and the injection of glycerin to relieve the anuria. No more than 24 hours should be spent in this effort, and if the anuria has lasted for more than three days, not even this waste of time is permissible—operation must be performed at once.

Watson and Cunningham collected 205 cases of calculous anuria, of which 95 were operated upon with 46 per cent mortality, 110 were not operated upon, with 72 per cent mortality.[1]

Huck [2] states that operation before the fourth day gives a mortality of 25 per cent; before the fifth day, 30 per cent; before the sixth day, 42 per cent.

No matter how perfect the x-ray picture, there must always remain some doubt as to the condition of the kidneys or the existence of secondary kinks above a stone low down in the ureter. Therefore, it is almost a universal rule that the x-ray findings should be neglected, and pyelotomy performed solely for the purpose of saving the patient's life, and removing any stones that may be found in the pelvis of the kidney. Watson has suggested that the pyelotomy should always be bilateral. I have acted upon this suggestion two or three times, and have never had cause to regret it. There is certainly a lesion in both kidneys—the patient's life is seriously endangered through their lack of function; they had both better be drained.

No immediate attention need be paid to a stone low down in the

[1] "Genito-Urinary Diseases," 1908, ii, 193.

[2] Quoted by Walker, "Genito-Urinary Surgery," 1914, p. 282.

ureter. With relief of pressure by drainage of the kidney pelvis, this stone may pass spontaneously and with scarcely any pain. I have twice known this to happen after operation for calculous anuria.

Treatment During a Period of Quiescence.—Patients known to possess renal calculi which are not causing symptoms fall into two classes:

1. Patients who have not passed the ureteral calculus that has caused a colic.

2. Patients whose renal calculi have remained silent in the pelvis until they have attained a great size and have caused grave pyelonephritis or pyonephrosis.

If a ureteral calculus having caused a renal colic remains in the ureter, and radiography shows that its transverse diameter does not exceed 1 cm. every effort should be made to encourage its passage. The patient should drink as much water as possible, and attempts may be made at oil injections through the ureter catheter, though these usually fail. Fully one-half of such calculi pass spontaneously, however, and one may properly await their discharge for fully six months.

If a radiograph is taken from time to time, and shows that the stone is moving downward toward the bladder, this is an encouraging symptom, while the recurrence of colics and immobility of the stone discourage delay. Precisely how long one should wait in any given case must be decided empirically. I once encouraged a patient to await the passage of his stone, this being half way down his ureter and causing him little impairment of the renal function. Yet his next colic was followed by rupture of the ureter. I performed an emergency operation and he recovered after a stormy and prolonged convalescence.

If the stone is 2 cm. or more in width, it will probably not pass, and dangerous complications may be prevented by early operation.

RADICAL TREATMENT

But if the patient with quiescent stone is of the other type, with a large stone in a suppurating kidney, while he may go for years without grave symptoms, he is, nevertheless, in a state of unstable equilibrium, carrying about within him a septic focus, the source of probable infection to the other kidney, and a deteriorating influence upon his whole economy. He may at any time fall a victim to an acute renal infection or to a general septicemia, and, like the patient with a smoldering appendix, he should be urged to operation. The operation of choice is nephrectomy, if the opposite kidney can support life.

If both kidneys are full of calculi, bilateral simultaneous nephrotomy is the operation of choice. The kidney with the better function should be operated upon first.

By the same token the only reason for hesitating to remove a stone from a solitary kidney is the fact that the function of this kidney is too impaired to withstand operation.

The Treatment of Calculous Pyelonephritis.—Renal suppuration due to stone is only one degree less benign in appearance and less malignant in reality than anuria. Suppuration caused by calculus cannot be overcome by any medical or hygienic treatment. Unless the stone can be passed off spontaneously—an outcome to the last degree improbable in suppurating cases—its growth is fostered by secondary phosphatic deposit, while the irritation it provokes in turn feeds the renal suppuration. The stone must be removed.

Pyonephrosis and perinephritic abscess, whether calculous or not, require radical surgery.

Methods of Radical Treatment.—The radical treatment of renal and ureteral calculus consists of three operative procedures: nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy (pyelolithotomy or ureterolithotomy) is incision of the kidney (pelvis or ureter) for the purpose of extracting a stone. The term has been restricted to operations performed upon the aseptic kidney, to distinguish them from nephrotomy performed upon the suppurating kidney. This distinction is valuable from a surgical point of view. The term nephrolithotomy, therefore, will be employed to designate extraction of a stone from a nonsuppurating kidney, while nephrotomy, in this connection, will imply lithotomy of a suppurating organ.

Indication for Operation.—The general indication for operation is the presence of a stone too large to pass down the ureter. If the calculus is too large to pass of itself it must be removed by the surgeon. In the preceding paragraphs the modifying circumstances have been discussed—the delusive nature of the calm succeeding a renal colic, the imperative necessity for operation during anuria, the futility of delay when the kidney is suppurating.

The mortality from nephrolithotomy, pyelolithotomy and ureterolithotomy does not run above 2 to 4 per cent. Such a prospect, with its assurance of future safety, its lack of present danger, and its unimportant discomforts, outweighs a single renal colic, and is not for a moment to be compared with the progressive unsafety and discomfort to which a patient subjects himself by refusing operation.

The advantage of early operation, before the kidney becomes infected, is still further enforced by the relative mortality of nephrolithotomy, nephrotomy, and nephrectomy. Nephrolithotomy—the removal of a stone from an uninflamed kidney or ureter—has, as remarked above, a mortality of 2 to 4 per cent. Nephrotomy—the incision of a septic kidney—has a mortality of 20 per cent to 25 per cent, while the mortality of nephrectomy in like conditions runs from 30 per cent

upward. Add to this the mortality of nephrotomy for calculous anuria (50 per cent), and the conclusion is obvious that the patient who refuses surgical relief while the kidney is yet uninflamed spurns a comparatively safe and sure cure and subjects himself to a disease which, apart from its other dangers and discomforts, may at any moment bring him to a critical condition of renal obstruction or suppuration, from which he can only escape by submitting to an operation many times more dangerous and distressing than the one he seeks to avoid. Furthermore the longer operation is deferred the greater prospect is there of irreparable damage to the kidney, and also the persistence of stricture or obstruction in pelvis or ureter calculated to cause prompt relapse of stone and persistence of fistula.

CHAPTER XLI

CALCULI AND FOREIGN BODIES OF BLADDER AND URETHRA

VESICAL CALCULUS

Number and Shape.—Single calculi are generally ovoidal in shape (Figs. 27 to 29; 71 to 73; Pl. I).

Multiple calculi are usually phosphatic, less frequently urates. In general, their number bears an inverse relation to their size. When few

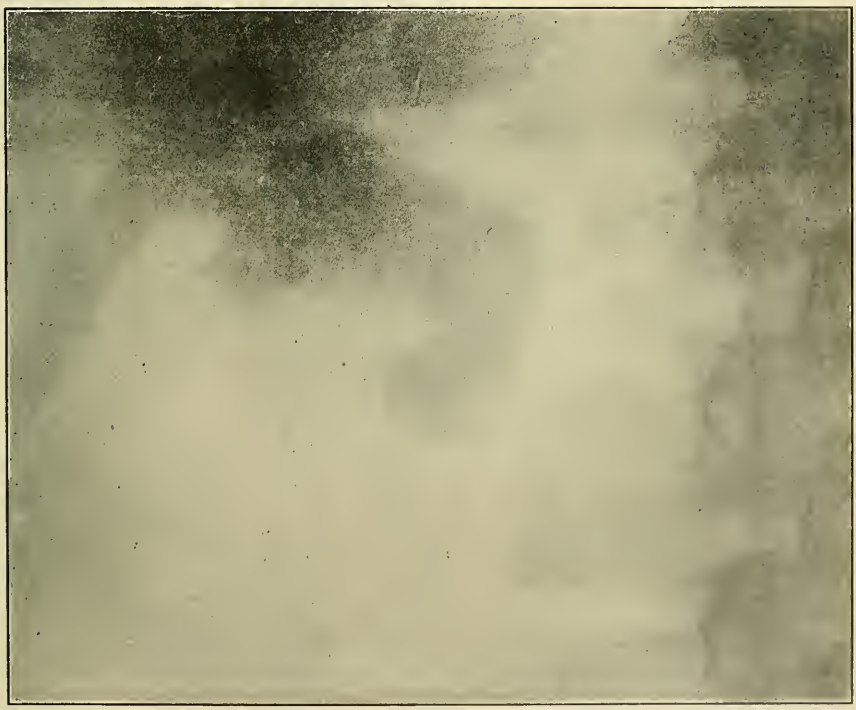


Fig. 83.—Large Renal Calculi. Radiograph by Dr. MacKee. The patient's only symptom was an occasional renal colic. General health excellent. Refuses operation.

in number they influence one another's shape and grow to be many-sided rather than rounded (Figs. 74, 76). Hence when a stone passed spontaneously presents one or more flat sides or facets, the presence of other stones may be inferred.

Fantastic dumbbell and other shapes are assumed by encysted calculi (Fig. 83), part of the stone taking the shape of the pocket which contains it, while the remainder protrudes irregularly into the vesical cavity.

Size.—Partly on account of the infrequency of stone, partly on account of the surgeon's omnipresence, large stones are rarely seen in this day and in this country. The largest stone in my collection weighs 13 ounces. Dr. Thomas Smith [1] removed a stone weighing 24½ ounces, and Lieutenant-Colonel Bamker [2] one weighing 25 ounces. Such large stones are always phosphatic.

Sex.—Not more than two or three per cent of bladder stones occur in women (if we except incrusted ulcers). I have operated on 59 men and no women; my father on 250 men and 3 women.

Source.—A few vesical calculi are formed in the bladder about foreign bodies, while others can be traced by the history of a renal colic as having descended the ureter and been caught in the bladder. But in the majority of cases no such clear history is obtainable. There are certain probabilities worthy of enumeration; thus the following stones usually originate in the kidney: Congenital stones, stones with a history of renal colic, oxalate stones. While the primary bladder stones, apart from those actually formed around foreign bodies, are likely to be composed largely of yellow urates and to be associated with a slight retention of urine, this slight retention being a frequent cause for the relapse of such stones when they are removed. Beck's [3] assertion that almost all vesical calculi are of renal origin is absolutely not borne out by the facts. Urate calculi are found at least ten times more often in the bladder than in the kidney.

SPONTANEOUS FRACTURE [4]

Spontaneous fracture is apparently due to long-continued dilution of the urine, which weakens the colloidal framework of the stone sufficiently to permit it to break into pieces. This rare phenomenon has been taken advantage of by the purveyors of various lithia waters. The claim that any water or drug will even probably cause spontaneous fracture of stone is not supported by experience. Moreover, when the calculus does break it is not to be expected that all the fragments will be expelled. One or more remain in the bladder, and around these as nuclei new stones will form. Almost all the reported cases of fracture have occurred in pure uric acid calculi. I have seen one such case.

[1] *Lancet*, 1886, ii, 244.

[2] *Med. Record*, 1900, lviii, 637.

[3] *Jour. A. M. A.*, 1908, li, 885.

[4] Cf. Englisch, *Archiv f. klin. Chir.*, 1905, lxxvi, and Kasamowski, *Folia Urologica*, January, 1909.

SYMPTOMS

There is no symptom, no set of symptoms, absolutely and invariably pathognomonic of stone in the bladder, except the physical signs elicited by the surgeon's examination. Yet there is a certain group of symptoms which is very suggestive of stone. Chief among these are frequency of urination, pain, and hematuria, occurring by day and increased by exercise.

Fig. 84.—Silent Vesical Calculi.

Frequency of Urination and Pain.—These are usually intense. The distress is usually less during the night while the patient lies quietly on his back, and during the day so long as he is still. But every jolt induces spasm. When walking the patient moves slowly and gingerly, almost on tiptoes. Riding over a rough road or in a railroad train, or even walking downstairs, is misery. The pains are situated chiefly in the glans penis, along the pendulous urethra, and in the perineum. The desire to urinate is quite irresistible. As a result of some extra exertion or an acute infection, the patient, from time to time, has what is known as a *fit of the stone*. During this time his pains are greatly intensified. He may have to urinate as often as every ten or fifteen minutes day and night, so that he spends his time in one long spasm.

As the stone grows larger and the cystitis more intense these paroxysms become more and more frequent. They exhaust the patient's strength, and during them he resembles a woman in the second stage of labor. In children, prolapse of the rectum and involuntary defecation are common results of this straining, while adults complain of hemor-

rhoids, pass blood by the rectum, and during the paroxysms suffer from unavoidable escape of intestinal flatus and often of feces. When there is considerable prostatic hypertrophy or the stone is encysted, there is less tendency to pain, so that even with intense cystitis the paroxysms may be neither frequent nor severe.

Exceptionally the pain is absent or nocturnal in the absence of prostatism. Thus my two most recent litholapaxies were performed on men, one of whom had never had any pain, though horseback riding made him bleed (Fig. 84), while the other had more pain when lying down than when sitting up. Both had large acid stones, the latter weighing 41 gm.

Hematuria.—Hematuria, like the characteristic pain, is traumatic in origin, and is, during the first stages of the disease, only aroused by some jolt. It is usually associated with pain, and the hemorrhage, though profuse, is usually short-lived. Later in the disease the perpetual straining due to cystitis may make the hematuria quite continuous.

Stoppage.—Sudden stoppage of the urinary stream is a symptom of stone which is neither characteristic nor common. It is caused by the stone rolling into the vesical orifice and plugging it like a ball-valve. Striking cases, like that of Sir Henry Thompson, whose patient could urinate only while lying on his back, are most uncommon. Prostatics with stone do not show this symptom, and it may be caused by prostatic or vesical tumor.

In children certain special symptoms are associated with stone, notably priapism and a tendency to pull at the prepuce.

Certain reflex pains in the back, testicle, etc., are among the infrequent symptoms of stone in the bladder; they are due to prostatic irritation.

DIAGNOSIS

In these cystoscopic days when every obscure case of bladder or renal infection submits to cystoscopy and radiography, one is not surprised occasionally to find an unlooked-for bladder stone. Stone is suspected when the previously related symptoms are found.

If the bladder is much inflamed, the cystoscope may not readily distinguish a stone from a sloughy tumor, or from a tumor incrusted with phosphates. If there is any doubt the cystoscope may be used as a searcher to tap against the stone. The sensation imparted distinguishes the solid stone.

Large stones can be readily diagnosed by tapping with almost any urethral instrument excepting a soft rubber catheter; even the woven catheter will strike its end against the stone and give the characteristic impact.

Small stones, on the other hand, are very elusive, and are not found readily by the old-fashioned searcher while the encysted stone and the stone behind the prostate elude this as well. For these reasons the stone searcher has quite fallen into disrepute, and been replaced by the cystoscope.

The presence of bladder stone leads to the suspicion of renal stone; this should be proven by x-ray and renal function tests.

PROGNOSIS

Unless the stone is small enough to be viable through the urethra, there is only one prognosis—it will certainly remain, and the symptoms will inevitably grow more severe until it is removed by operation.

TREATMENT

The treatment of stone in the bladder is operative. The choice of operation depends in some measure upon the patient's condition, in some measure upon the surgeon's skill. The surgeon may choose between three operations: litholapaxy, suprapubic and perineal lithotomy.

The performance of litholapaxy requires a training and an opportunity for performing the operation with relative frequency which few, even among specialists, can command. Litholapaxy is the operation of choice at the hands of a skilled operator for all uncomplicated and relatively small cases of stone in the bladder. Each surgeon must decide for himself what type of case he considers suitable for the operation. In India, where bladder stones are extremely frequent among young people, litholapaxy is preferred above all other operations, even for large stones. In this country, where stones are relatively few, and usually due to retention of urine, many specialists do not perform litholapaxy at all. I prefer the operation in adults for uncomplicated stone up to about a diameter of 4 cm.

Suprapubic lithotomy is the operation of choice for large stones, for children, for stones the result of prostatism, or other pathological conditions about the bladder requiring operation. Its mortality is slightly greater, its convalescence slightly longer than litholapaxy. I have never lost a patient after litholapaxy, though I have several times had to repeat the operation on account of fragments left behind at the first crushing.

Perineal lithotomy is the operation of choice when some condition in the urethra, such as stricture, requires a perineal section.

The mortality of operations upon large bladder stones is extremely high, because these cases invariably have a gravely impaired renal function through chronic renal infection. Preliminary examination by

phenolsulphonephthalein discloses this condition and indicates the necessity for great care in the selection of an anesthetic. Generally speaking, such cases should be operated upon by suprapubic lithotomy under a local anesthetic.

FOREIGN BODIES OF THE BLADDER

Foreign bodies may enter the bladder down the ureter, through the wall of the bladder, or up the urethra.

Ureteral.—Crystals, stones, blood clots, shreds of tissue, descend the ureter and may be caught in the bladder.

FIG. 85.—STONE ON TWIG. NATURAL SIZE.

Parietal.—Apart from the substances which may be introduced through wounds, there are two types of parietal foreign bodies. One consists of the gauze sponges, etc., that may be left in the bladder at the time of operation, and the silk sutures with which the bladder may be tied and which work their way into that organ. The second class of parietal foreign bodies reach the bladder through the bursting and emptying of the abscess containing them into the bladder, of such objects as pins may, of their own impetus, migrate into the bladder without suppuration.

Urethral.—Foreign bodies are introduced into the bladder through the urethra by the insane and the pervert. This practice is much more common in certain European countries than in the United States. These foreign bodies are much more likely to slip through the short urethra of a woman than that of the man. Consequently, they are much more commonly found in women's bladders. The substances usually employed are chewing gum, hair pins, and hat pins.

In this manner every substance that the urethra will admit has at one time or another been introduced into it, and been found in the bladder subsequently. It were a waste of time, therefore, to attempt any specific enumeration. The curious may refer to the exhaustive monograph of Englisch.[1]

[1] *Deutsch. Zeitschr. f. Chir.*, 1906, lxxxix.

A generation ago it was not uncommon for catheters to break off inside the bladder; improvement in their manufacture makes this accident most uncommon nowadays, but our intravesical operative instruments sometimes break and are thus lost.

Blood clots and bits of sloughing tissue left in the bladder after operation form the nuclei of postprostatectomy calculi.

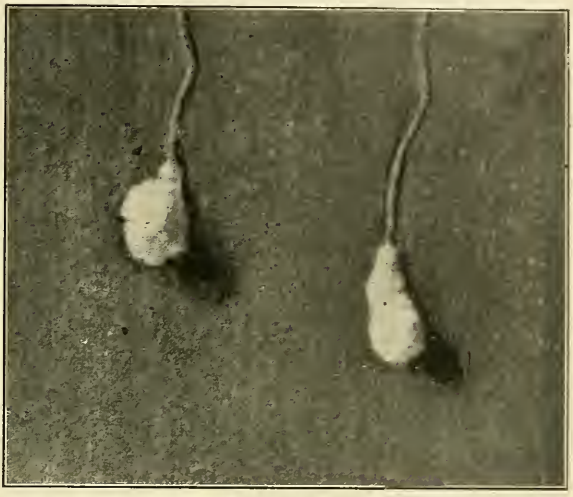


Fig. 86.—Stones Formed on Hairs of a Dermoid Cyst Ruptured into the Bladder. Natural Size.

Results.—The foreign body may remain silent in the bladder for a considerable length of time, especially if it be small, rounded or soft. But sooner or later staphylococcus or streptococcus infection occurs, phosphatic incrustation ensues, and a phosphatic stone develops around the foreign body as a nucleus (Fig. 85). The symptoms thereafter are those of stone. Such stones are usually best attacked by cystotomy, though gum, pins, etc., may be extracted by means of the cystoscopic forceps.

PILIMICTION

The one special type of vesical foreign body which has received distinguished mention in the past is best known under the title of "pilimiction"—the urination of hair. My father had one such case, an insane patient, who introduced the hair into his bladder through the urethra; but it may be set down as an almost universal rule, if the patient urinates hair, or stone formed upon hair (Fig. 86), that this comes from a dermoid cyst which has ruptured into the bladder. Heller[1] has collected 57 cases of this condition. I have seen one case which was readily identified by cystoscopy. The treatment required is excision of the dermoid cyst.

[1] *Zeitschr. f. Urol.*, 1913, ii, 1.

URETHRAL FOREIGN BODIES

Foreign bodies may enter the urethra at either extremity or may develop in and about the canal.

From without:		Fragments of surgical instruments. Substances introduced by the intoxicated, insane, or sexually perverted.
From within:		Renal or vesical calculi, or any substance which might form a nucleus for such calculi.
Originating in or about the canal.	Stone:	Formed about a foreign body, or in an ulcerated spot, pocket, or fistula. Prostatic calculus.

Varieties.—The most varied substances are found in the urethra, introduced by the patient under the influence of that perverted and depraved sexual instinct which affects the male of all ages who gives up his mind to impure thoughts and whose sexual necessities are not gratified.

Seeds, stones, beads, beans, peas, nails, pins, needles, hairpins, slate-pencils, portions of glass, wax, cork, and a host of other substances are thus introduced into the meatus and, slipping beyond the reach of the fingers, are not infrequently swallowed by the urethra. Broken catheters and bougies, especially in cases of stricture, and instruments left *à demeure,* if not well fastened, may slip past the meatus and travel toward the bladder. Their tendency is to slip persistently onward, not because of any urethral suction or peristalsis, but merely because they are introduced blunt end first, and consequently, unless quite round, the outer end is likely to be the sharper. Therefore every erection or effort at extraction, if it move the foreign body at all, pushes it inward. Rounded bodies, such as beans or pebbles, lie in the natural pouches of the canal (fossa navicularis, bulbous urethra) or become arrested by stricture.

If foreign bodies are not removed, one of three consequences follows: 1. They travel on into the bladder and form a nucleus for stone there; or, 2. Stone forms around them in the urethra; or, 3. They cause urethritis, retention of urine, and finally either become encysted or ulcerate their way out, producing fistula and stricture.

Treatment.—If the body be long and soft (catheter, piece of wood), it may be transfixed with a stout needle through the floor of the urethra and the canal pushed back over it, like a glove over a finger, as far as possible, when it may be transfixed again, and so urged forward until it reaches the meatus. In manipulating with forceps, if the finger on the outside can detect and get behind the foreign body, nothing should divert the surgeon from keeping up pressure at that point in order to

prevent his instrument from pushing the offending substance still deeper into the canal.

If the foreign body lies behind a stricture, the latter must be cut or rapidly dilated to allow the passage of an instrument suitable for extraction.

Pins and needles may be extracted through the floor of the canal if their blunt ends can be steadied. To remove a pin its point is pushed through the urethral floor and its shaft drawn out until the head can be turned so as to extrude through the meatus.

My father once extracted a pin with Thompson's divulsor, and Dieffenbach removed one from the membranous urethra by pushing it with his finger in the rectum until the point protruded through the perineum, and then forcibly extracting it.

All other manipulations failing, perineal section will reveal the position of the object and permit extraction. The penile or the scrotal urethra should not be incised for fear of fistula in the one case, infiltration in the other.

URETHRAL CALCULUS

Urethral calculus is usually a urinary calculus arrested in the urethra. Less often it forms *in situ*—e. g., about a foreign body or behind a stricture. Prostatic calculi are mentioned below.

Englisch [1] has collected 113 cases of calculi in the prostatic urethra, 149 in the membranous canal, 68 in the bulb, 103 in the penile and scrotal regions, and 41 in the fossa navicularis.

The calculi are elongated in shape, faceted if numerous, and if neglected grow to considerable size and form pouches in which they lie.

They may grow to enormous size. Thus Britneff [2] has collected from Russian publications records of urethral calculi weighing, respectively, 427 and 420 and 402 gm. Babes [3] records the spontaneous expulsion through the female urethra of a stone, 3x4.5x6.5 cm., weighing 76 gm. She was left with incontinence of urine.

Symptoms.—If the calculus comes from the bladder the onset of symptoms is sudden. As it enters the urethra during urination the flow stops suddenly, while a sharp pain is felt. A second effort may extrude it from the canal or only impact it more firmly, or it may fall back into the bladder and remain a vesical calculus. Once impacted, it may cause complete retention, or, more commonly, dysuria.

If, on the other hand, the stone forms *in situ,* the onset of symptoms

[1] *Archiv f. klin. Chir.,* 1904, lxxii, 487; *Centralbl. f. Harn. u. Sex. Org.,* 1904, xv, 18, 81, 135.

[2] *Rev. Clin. d'Urol.,* Sept., 1912.

[3] *Ibid.,* March, 1913.

is insidious. First, there is slight gleet and some difficulty in urination. The gleet becomes slowly worse, and finally periurethritis occurs, which goes on to extensive suppuration and fistulization.

Periurethral calculi may remain latent for a long time, until they obtrude upon the lumen of the urethra or excite suppuration in the pocket within which they lie.

Diagnosis.—A sharp attack of urethral colic is unmistakable, but the less acute conditions just described simulate stricture of the urethra; indeed, stricture and stone often co-exist. The mistake is not a vital one, however, for any attempt at dilatation will evoke a grating sound characteristic of stone, and the calculus may be felt between the instrument and the finger externally.

Treatment.—In acute cases an attempt may be made to push the stone back into the bladder if it has not passed the membranous urethra; or, if it has passed, the anterior urethra may be distended with olive oil and the stone worked forward to the meatus, whence it may be extracted by crushing or by meatotomy. These failing, the meatus may be pinched and the patient encouraged to urinate; when the canal is fully distended the meatus is released and the stone expelled by the gush of urine. The urethral lithotrite is a dangerous instrument and of doubtful utility. The scoops and forceps of Collin and Leroy d'Etiolle, though ingenious, are never at hand at the right moment. When these methods fail external urethrotomy succeeds.

Periurethral calculus calls for external urethrotomy to remove the stone, to excise the pocket in which it lies, and to divide the stricture.

Infiltration, abscess, and fistula are considered in Chapter XXVII.

PROSTATIC CALCULUS

Urinary calculi may lodge in the prostatic urethra or phosphatic incrustations may form on granulations in the canal or in a fistula leading from it. These are urethral rather than prostatic calculi.

True prostatic calculus is a concretion formed of phosphatic salts and epithelial detritus in the acini of the gland. Such calculi are not uncommon in men past middle life; they form in the deeper portion of the glandular substance of the lateral lobes, in the line of cleavage between that part of the lobe which is enlarged in prostatism and the so-called capsule.

Prostatic calculi are usually multiple, and do not exceed the size of a millet seed. They always contain lime salts and show extremely well by x-ray throwing a characteristic mottled shadow of a generally rounded outline which delimits the position of the prostate (Pl. III). Exceptionally, the calculi attain a much larger size; I have known

them to attain a diameter of 3 or 4 cm. Under these circumstances, the calculi are single or not more than three or four in number.

The common millet seed calculi are usually of no importance. Exceptionally they excite suppuration in the gland which may result in sclerotic prostatitis and contraction of the bladder neck (I have seen two such cases). I have seen two cases of severe suppuration in the testicle due to a primary focus of infection about a prostatic calculus.

On the other hand, the larger calculi cause a slight degree of prostatic obstruction (I have never known this to assume any importance), producing mild bladder irritability with small quantities of pus in the urine. These cases often elude diagnosis because one does not think of the possibility of prostatic calculus. The first case of the kind I ever saw had had a kidney removed for tuberculosis and was being treated by lavage of the renal pelvis. The prostate in such cases may be only slightly enlarged, and this enlargement may then be put down as an ordinary hypertrophy. Careful palpation, however, is likely to reveal the irregular outline of the stone or of the scar tissue surrounding it. Indeed when the stones grow very large they produce precisely the effect of carcinoma of the prostate to the examining rectal finger. Indeed so precise is the simulation of carcinoma, both in the clinical picture and the enlargement as felt by rectum, that the only way to avoid mistakes is to x-ray every case of supposed carcinoma of the prostate in which the presence of carcinoma is not absolutely proven by palpable thickening in the middle line or by evidences of growth beyond the limits of the prostate gland.

The prognosis of prostatic calculus is absolutely good. Although the stones do not usually attain any great size until the patient is quite aged, I have never known such cases to do any more harm than to cause pain which is usually quite bearable, epididymal or prostatic suppuration which may require operation, and contracture of the bladder neck which may cause retention in a relatively young man.

The treatment is operative. The stone should be removed by suprapubic prostatectomy. I have operated both above and by the perineal route, and can most highly commend the suprapubic method of approach.

PREPUTIAL CALCULUS

These resemble urethral calculi in that they may descend from above or be formed *in situ,* and have been exhaustively studied by Englisch.[1] They are extremely rare.

[1] *Wien. med. Presse,* 1903, No. 47-49.

CHAPTER XLII

GENITO-URINARY TUBERCULOSIS

Tuberculosis can never be amputated. Its lesions are indeed usually localized, and these lesions are subject to cure. But the disease itself is not curable in the sense that we can guarantee the patient against a relapse. Tuberculosis of the urinary and genital tract is spoken of very often as though it were a thing apart. This it is in the clinical sense. Its activity is not usually coterminus with tuberculous processes elsewhere in the body, yet it is only one of the manifestations of tuberculosis, and a relatively rare one. But, although urinary and genital tuberculosis stands clinically alone in the majority of instances, there is practically always accompanying or antecedent pulmonary tuberculosis. This is often inactive, and only to be revealed during life by the x-ray. Kocher records 451 autopsies on cases of tuberculosis of the urinary and genital organs, 80 per cent of which showed pulmonary lesions active or inactive. Waldschmidt[1] found 89 per cent.

The association of urinary and genital tuberculosis is not very close in the female, but fully one-third of the men with tuberculosis of the epididymis have tuberculosis of the kidney as well.[2] G. Walker[3] quotes Saxtorph's record of 10,016 autopsies with 547 cases of tuberculosis of the genital and urinary organs. The kidneys showed miliary lesions 342 times, the bladder 4 times. There were 205 cases of chronic tuberculosis. Walker further collected 279 cases of genito-urinary tuberculosis, in 184 of which the kidney was the first organ attacked, in 80 the epididymis, in 6 the prostate, in 6 the fallopian tubes, in 2 the seminal vesicles, and in 1 the uterus.

Clinically the disease begins as a general miliary tuberculosis (which interests us not) or else it begins definitely in one of the organs involved. *In the urinary tract tuberculosis almost always begins in the kidney* though exceptionally it may begin in the prostate. *It never begins in the bladder.*

In the genital tract it usually seems to begin in the epididymes though the site of the first invasion in the genital tract is not definitely known. I happen to have seen a number of cases of tuberculosis of

[1] *Berl. klin. Wochenschr.*, Sept., 1912. [2] *Annals of Surgery*, June, 1907.
[3] *Ibid.*, February, 1907, p. 249.

the prostate without tuberculosis of the epididymis, and among the many cases of tuberculosis of the epididymis that I have studied none showed an absolutely normal prostate. For these, and for other reasons it is my impression that genital tuberculosis does not begin in the epididymis. Barney has argued both sides of this question.[1] He pins his faith on the biological fact that the epididymis is allied in origin to the kidney, and may therefore be considered an excretory organ, wherefore it may perfectly well be infected from the circulation by tubercle bacilli. But Blandini and T. Walker [2] have independently shown that a tuberculous epididymis may be experimentally produced by inoculating the urethra and bruising one of the testicles.

The source of origin of genital tuberculosis remains obscure because when cases are seen clinically, all of the genital organs are likely to be involved on one side, epididymis, vesicle and prostate.

When then is the source of infection, the blood stream, the lymphatics or coitus? Bulkley [3] favors the latter theory, and has collected the evidence in its behalf. George Walker, however, says "it is possible that either the male or the female may become infected during coitus, but such an occurrence is extremely rare and the few instances which have been reported are open to doubt." A few voices are raised in favor of lymphatic origin of the infection, especially for a direct lymphatic invasion of the kidney from a tuberculosis of the base of the lung. But the majority speak in favor of an infection from the blood stream.

It has been believed that gonorrhea was a frequent cause of tuberculosis of the urinary and genital tract. Kummell,[4] for instance, supports this view. But the experience of most observers leads to the conclusion that the association of the two diseases is either accidental or actually founded on erroneous diagnosis.

Age.—Genito-urinary tuberculosis is a disease of young adult life. It is commonest between the ages of 15 and 40, though congenital cases both of renal and of epididymal tuberculosis have been reported, and George Walker's table of 375 cases shows 29 above the age of 50.

The Progress of the Lesions.—In the urinary tract the tuberculosis, beginning in the kidney, descends to the ureter, infects the bladder and perhaps the prostate, and then may ascend to the opposite kidney. In the genital tract, beginning in the prostate or vesicles, it extends first to one epididymis, and often later to the other, while the bladder may be infected directly from the prostate. Urethral and penile infection is extremely rare.

[1] *Am. Jour. of Urol.*, December, 1911, vii, 459; *Boston Med. & Surg. Jour.*, June 19, 1913, clxviii, 923.

[2] *Lancet*, 1913, clxxxiv, 435.

[3] *Am. Jour. of Med. Sciences*, April, 1915, cxlix, 535.

[4] *Therapie der Gegenwart*, December, 1910, li, No. 12.

CHAPTER XLIII

TUBERCULOSIS OF THE KIDNEY

PATHOLOGY

Tuberculosis causes three recognized types of pathological change in the kidneys:

Acute miliary tuberculosis.

Surgical tuberculosis.

Toxic tuberculous nephritis.

ACUTE MILIARY TUBERCULOSIS

Miliary tuberculosis of the kidney is but a part of general visceral tuberculosis. It has no interest for the surgeon.

SURGICAL TUBERCULOSIS

Chronic or surgical renal tuberculosis begins and develops as a characteristically localized and unilateral disease. Infection of the opposite kidney is usually surprisingly slow to develop. Hallé and Motz found, for instance, in 131 post mortem examinations, 89 unilateral cases of renal tuberculosis. The first lesion of chronic renal tuberculosis usually appears near the base of one of the papillae [1] at the upper or lower pole of the kidney; the central portion of the parenchyma is singularly exempt from involvement. This first lesion is a characteristic tubercle, crowded with tubercle bacilli. The lesion spreads by three methods:

1. The lesion itself enlarges by extension of round-cell infiltration which ultimately breaks down to form a cheesy nodule or cyst; or if it reaches the kidney pelvis a tuberculous ulcer.

2. Lymphatic absorption gives rise to new tuberculous foci in various parts of the kidney (notably distributed in wedge shape from the original lesion toward the kidney cortex). These tubercles in turn coalesce and break down.

3. In the meanwhile, *toxic tuberculous nephritis* affects portions of

[1] Cf. Ekehorn, *Nord. med. Ark.*, 1914, xlvii, No. 12. And Wildboltz, *Zeitschr. f. Urol. Chir.*, 1914, ii, 201.

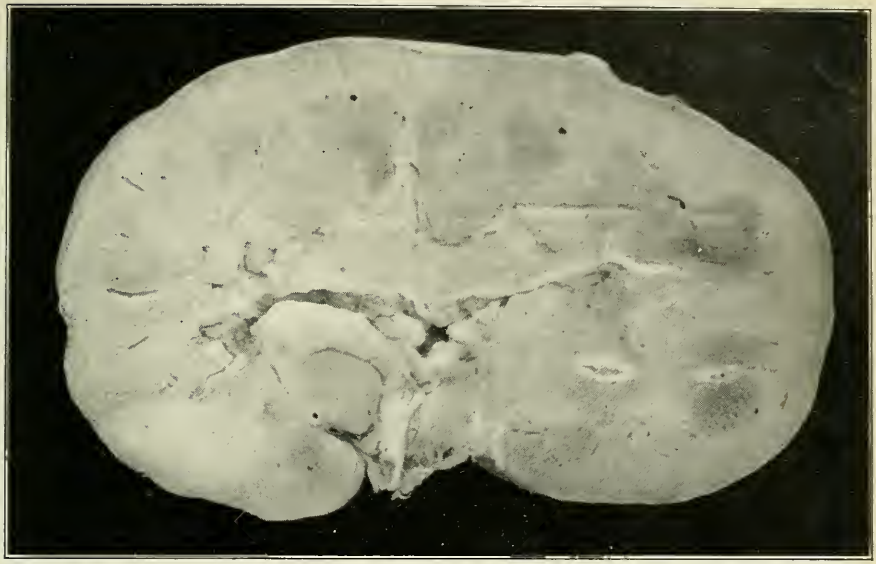


FIG. 1

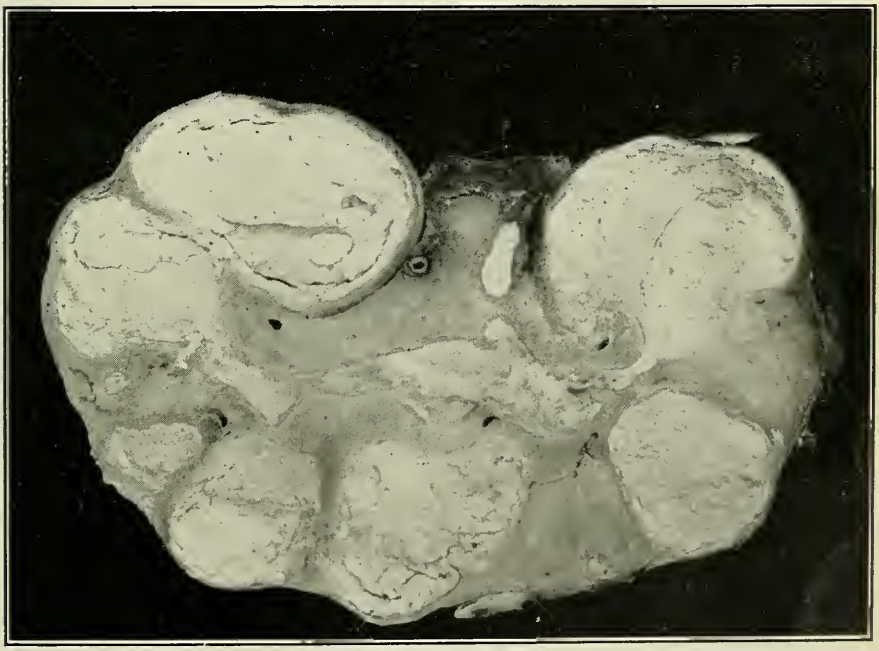


FIG. 2

RENAL TUBERCULOSIS.

FIG. 1.—EARLY RENAL TUBERCULOSIS. Uppermost papillae ulcerated. Pelvis already much contracted. Ureter only slightly involved.

FIG. 2.—COMPLETE CASEATION OF KIDNEY, PELVIS AND URETER. Nephrectomy to relieve bladder symptoms due to drag of shortened ureter.

FIG. 87.—RENAL TUBERCULOSIS. Upper pole a mass of tuberculous tissue; lower pole pyonephrotic; pelvis obliterated.

FIG. 88.—RENAL TUBERCULOSIS. Abscesses throughout, but chiefly at poles; fibrolipomatous and suppurating perinephritis; ureter obliterated.

the kidney not invaded by the actual tuberculosis and also ultimately affects the opposite kidney.

In the renal pelvis and ureter the tuberculous lesions begin as localized superficial ulcerations or a generalized infiltration which gives the surface of the ureter and pelvis a pebbled appearance. The inflammation soon extends to all the coats of the ureter causing a sclerosis and

FIG. 89.—RENAL TUBERCULOSIS. Abscesses at upper (T) and lower poles with renal tissue (R) between. Pelvis obliterated; ureter (U) thickened and dilated.

fibrolipomatous periureteritis and peripyelitis.[1] The ureter is thus much thickened, its lumen narrowed and strictured and its elasticity lost. If it is thus shortened, its vesical orifice is retracted, its peristalsis lost.

The usual ultimate result of these various lesions is total destruction by ulceration of the greater part of the parenchyma, so that in spite of thickening, ulceration and contraction of the actual pelvis, the cavity

[1] Hallé and Motz, *Guyon's Annal.*, 1906, xxiv, No. 3 and 4.

FIG. 1

FIG. 2

RENAL TUBERCULOSIS.

FIG. 1.—BEGINNING TUBERCULOUS HYDRONEPHROSIS. Ureter obliterated. Parenchyma destroyed by ulceration. Pelvis dilating.

FIG. 2.—TERMINAL STAGE. Kidney caseous, atrophied, sclerotic. Capsule (stripped back) extensively tuberculous. Ureter much thickened.

of the kidney is enlarged into a multilocular pyonephrotic sac; while the remaining parenchyma is little better than scar tissue, and the whole is surrounded by a dense mass of fibrolipomatous perinephritis.

Out of these various lesions it is quite fruitless to attempt the description of pathological types. In the early stages the papillary or pyelitic ulcer may predominate (indeed the tuberculosis is sometimes spoken of as primary in the kidney pelvis [1]), or the miliary type may predominate, or the diffused tuberculoma; while toward the termination of the disease the prevailing lesions are those just described (ulcero - cavernous type) or there may be large cysts or cheesy foci or tuberculous hydronephrosis.

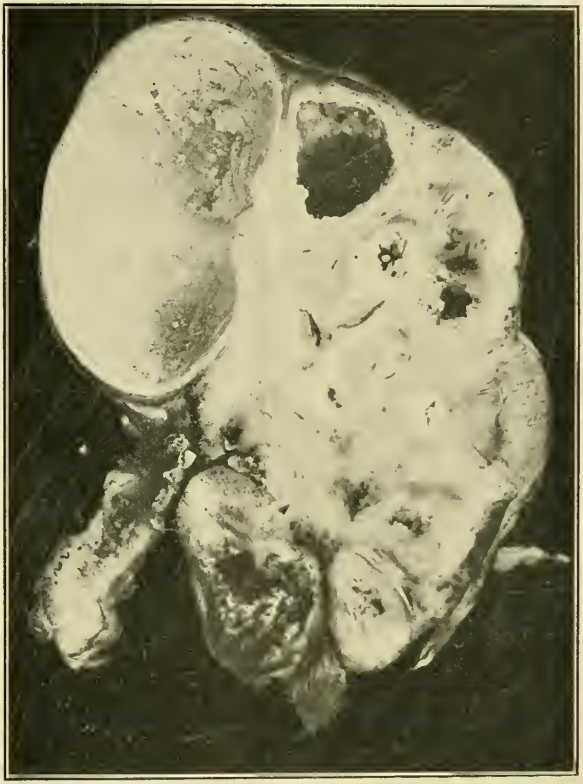


Fig. 90.—Renal Tuberculosis. Terminal Stage. Large cheesy focus above. Ulcerating and sclerotic lesions elsewhere. Pelvis obliterated. Ureter thick.

Perinephritic abscess is extremely uncommon. Mixed infection is unusual in the tuberculous kidney, but a pyogenic infection is not an uncommon occurrence in its fellow.

Bladder invasion results by direct extension of the disease from the ureter mouth to the adjoining region, notably the trigone. Thence it spreads to the orifice of the urethra (involving the prostate in the male) and of the opposite ureter. Thus the renal lesion extends to the male genitals, and thus it may stricture the orifice of the opposite ureter and cause hydronephrosis of the non-tuberculous kidney.

Whether *the opposite kidney* becomes infected by ascending or descending invasion is not proven.

[1] Buerger, *Interstate Med. Jour.*, 1914, xxi, No. 11.

TOXIC NEPHRITIS

Parenchymatous nephritis of the opposite kidney is very common. It may deliver a high percentage of albumin and many casts. This lesion, far from being a contra-indication to nephrectomy, is actually curable only by this operation.

SYMPTOMS

The symptoms of renal tuberculosis usually make their first appearance between the fifteenth and the thirty-fifth year.

The disease is very uncommon in childhood; indeed Oraison [1] has been able to collect only 51 cases of renal tuberculosis in children. Statistical reports derived from the autopsy table show a very large percentage of renal tuberculosis at a relatively advanced age. This is due to the remarkably chronic course of certain cases which may run from fifteen to twenty-five years, or if actually occluded, indefinitely.

Clinical Types.—Three clinical types of the disease are recognized, the predominant feature of which are the following:

Frequent and painful urination.

Hematuria.

Renal pain or colic.

None of these types is exclusive. Almost every case of renal tuberculosis has frequent and painful urination as its predominating feature; almost every case has some hematuria at one time or another; renal pain is a relatively rare symptom.

The Bladder Type.—The mere presence of a tuberculous focus in the kidney causes no symptoms beyond perhaps slight fever and polyuria. When such a focus bursts into the pelvis it is likely to cause a slight brief hemorrhage. (This often passes unnoticed.) The disease then spreads to the kidney pelvis and ureter, causing painful and frequent urination even before the bladder is infected. The bladder is soon invaded, however, and adds to the intensity of the symptoms.

Frequent and Painful Urination.—At first the frequency of urination is definitely more marked by night than by day, and is accompanied by polyuria which is also more marked by night. Ureteral catheterization at this early stage will show a marked polyuria from the diseased kidney. The total excretion of urea may even be greater from the diseased kidney, though its phenolsulphonephthalein output is always less. (I have seen but one exception to this rule.)

Pain may be felt before, during, or after micturition. But the most marked and characteristic pain is terminal (occurring at the end

[1] *Jour. d'Urol.*, 1913, iv, No. 1.

of micturition and continuing for some time thereafter). When intensified by lesions of the trigone, this terminal pain may be associated with terminal *hematuria*.

Hematuria.—The hematuria of renal tuberculosis assumes three forms which we may describe in order of their frequency:

Microscopic hematuria (a few red blood cells and a trace of albumin) occurs from time to time in all cases.

Slight visible hematuria (either a smokiness in the urine or more commonly a distinctly terminal hematuria) is likely to occur as soon as the bladder has become considerably infected. Later, this usually ceases.

Massive hematuria (renal hemoptysis, as it has been called) is rare; but it may dominate the scene. It occurs early, like pulmonary hemoptysis, and in the absence of other symptoms may suggest neoplasm.

Fig. 91.—Renal Tuberculosis. Complete destruction by sclerosis; yet the only symptom had been hematuria, twice in six years from the ulcerated papilla at lower pole.

Renal Pain and Colic. — Renal pain, while not nearly so common a symptom of renal tuberculosis as hematuria, bears much the same relation to the clinical picture. Moderately severe loin pain, associated with tenderness of the kidney, occurs in perhaps 50 per cent of cases. Renal colic is rare, but may occur at any time from the passage of blood clots or shreds of tissue through the narrowed ureter. Renal pain, or colic sufficiently severe to dominate the scene is unusual.

Crossed Pain.—Renal pain may occur in the healthy kidney as a result of compensatory hypertrophy of that organ. On the other hand severe pain in the opposite loin may be due to lesions entirely independent of the renal tuberculosis. One of my cases had frightful renal colics of this type which were apparently due to tuberculous seminal vesiculitis.

Fever and General Symptoms.—Slight fever and slight loss of weight doubtless occur from time to time in all cases of renal tuberculosis; but marked fever is rare and considerable loss of weight is due either to bilateral tuberculosis or to toxemia from ureteral retention. So long as retention is absent and the infection unilateral, the patient may apparently enjoy the most robust health. I shall never forget the first vision I had of a certain woman, subsequent operation upon

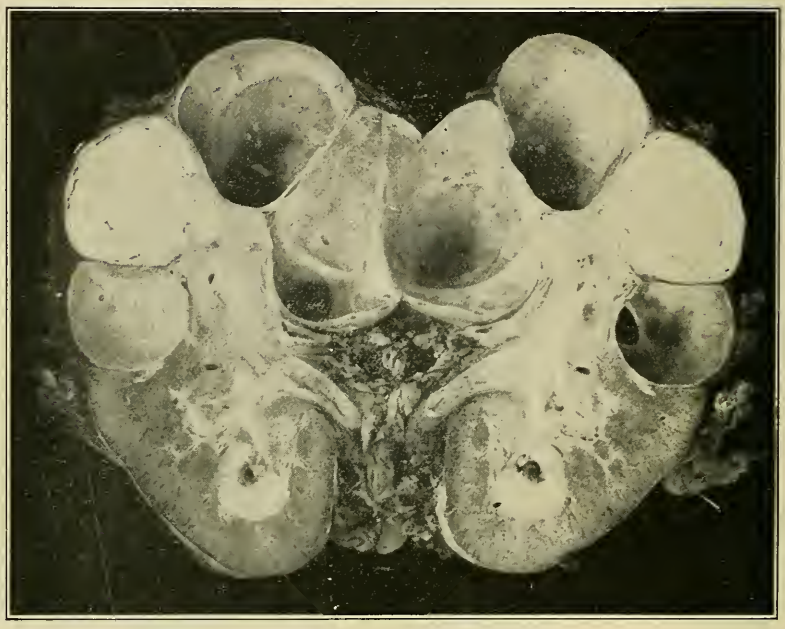


Fig. 92.—Renal Tuberculosis. Upper half of kidney cystic and caseous; yet ureter spared. Symptoms wholly toxic (digestive). Treated for years as dyspeptic.

whom proved her to harbor a completely destroyed pyonephrotic tuberculous kidney. As her 250 pounds lay in a hospital bed, surrounded by her anxious family, she apparently weighed as much as all the rest of them put together. But late in the disease the ureteral lesions are such that adequate drainage of the kidney is the exception. Considerable loss of weight, with slight fever, is the rule. Such is our interpretation of Israel's statement that he found fever in only 15 per cent of uncomplicated renal cases, but in 80 per cent of the cases complicated by bladder infection.

PHYSICAL SIGNS

The Urine.—Pus is practically constant in the urine in sufficient quantity to cloud it. I have failed to find it only twice; once in a case

of intermittent profuse hematuria, due to a small papillary ulceration, the other time in a case of closed pyonephrosis that was delivering no urine whatever.

Albumin is equally constant; usually a trace. The presence of any appreciable percentage of albumin usually means grave toxic nephritis of the opposite kidney, and is accompanied by casts. In the absence of this toxic nephritis casts are not likely to be found.

Blood is commonly present in microscopic quantity, and fully half the cases give a history of gross hematuria.

A striking feature of *the urine is* that it is likely to be *sterile on ordinary culture media* (if drawn from the bladder) *even though definitely purulent.* Such a sterile purulent urine is likely to be caused only by the tubercle bacillus or the gonococcus. Bacillus coli or other infection of the opposite kidney is, however, present in a large minority of cases.

The urine is acid unless rendered alkaline by mixed infection.

Tuberculous Lesions Elsewhere in the Body.—At the time of the first examination the bladder will be found infected in about 90 per cent of cases, the opposite kidney in from 10 to 20 per cent. Slight prostatic infection doubtless occurs early in many men, but is usually overlooked. The infection reaches the epididymis in only a small percentage of cases.

Radiographic evidence of tuberculosis in the lungs is usually obtainable though the clinical history is often silent on this point. Bone and gland tuberculosis are rare complications. It has been noted that a singularly large proportion of patients with genito-urinary tuberculosis die of tuberculous meningitis.

Diagnosis

It is impossible to make a full diagnosis of renal tuberculosis without the ureter catheter. The diagnosis must cover the following points: (1) The presence of urinary tuberculosis; (2) The origin of this tuberculosis in the kidney or in the prostate; (3) If in the kidney, which kidney is involved; (4) If one kidney is involved, what is the condition of its fellow; (5) Are there active lesions of tuberculosis elsewhere?

The suspicion of renal tuberculosis is aroused whenever there is spontaneous cystitis or prolonged pyuria, or bleeding great or small in a relatively young person. This suspicion is strengthened if the urine is acid, free from bacteria, yet purulent, and contains a trace of albumin, and microscopic or macroscopic blood. If the tubercle bacillus is found in the urine (see below) the existence of tuberculosis somewhere in the urinary organs is proven. The palpably large or tender kidney

may be tuberculous, or it may be the hypertrophied or hydronephrotic opposite kidney. If the radiograph shows a marked difference in the size of the two kidneys, the large kidney is usually the normal one in compensatory hypertrophy; for tuberculous pyonephrosis is usually small. Such are the hints—the proofs follow:

The Tubercle Bacillus.—In order to minimize contamination, especially with the acid-fast smegma bacillus, the urine should be drawn by catheter from the bladder (or the ureters). Bladder contamination with smegma bacilli is said not to be possible, yet I have twice been temporarily misled by the report of acid-fast bacilli morphologically resembling the tubercle bacillus obtained from bladder urine, and reported by a laboratory of good repute. So far as I know this mistake does not occur if the all-night decolorization is employed.

In early and active cases the tubercle bacilli are usually found readily and in large numbers. But in all cases it may be difficult to identify them both on account of their scarcity and on account of mixed infection: nephritis, etc. The antiformin and other methods of cleansing the urine are of some assistance in obviating this difficulty; the best method is probably that suggested by Crabtree [1] of centrifuging a number of tubes full of urine at the usual 300 revolution rate for 3 minutes, thus throwing down practically all of the pus, then centrifuging again at 1,000 revolutions until the urine is clear, thus throwing down the bacteria relatively uncontaminated.

Were it not for the delay involved, the accuracy of the guinea-pig injection test for tuberculosis would make this the test of choice in all cases; but two or three months is a long time to wait for a diagnosis, and though this period may be shortened by various devices, such as injecting the urine subcutaneously in the thigh of the pig and bruising its inguinal glands, these devices are not regarded as entirely safe by the best laboratory workers.

With typical clinical history, and cystoscopic and ureter catheter findings, the usual over-night stain suffices for a diagnosis. Indeed, even the guinea-pig may err. I have had two cases in which the temporary closing of the renal focus of infection permitted negative guinea-pig reports which were subsequently repudiated by relapse of symptoms, correct diagnosis, and nephrectomy.

Cystoscopy.—The alert expert will not fall into the error of considering every patchy or ulcerative cystitis tuberculous, nor will he believe a kidney tuberculous because its ureter mouth is inflamed (for the kidney above may be normal) or ulcerated, deformed or retracted (for the kidney above may be the seat of non-tuberculous inflammation). Indeed there is nothing absolutely characteristic about the appearance of a severe tuberculous cystitis, nor anything to prove that it is derived

[1] *Surg., Gynec. and Obstet.*, March, 1915.

from a primary lesion in the prostate or in either kidney. Early cystitis is often more suggestive in that it shows a strikingly patchy distribution of lesions, their tendency to group in the region of the ureter affected, and the appearance of characteristic little nodules (the so-called tubercles).

Tubercle Bacilli without Pus.—Although pus (and even bacilli) may be absent for brief periods from the urine of patients with small surgical lesions, the presence in the urine of *bacilli without pus* does not establish the existence of renal tuberculosis. Sufferers from advanced pulmonary tuberculosis often deliver bacilli in the urine, though subsequent post mortem shows no renal lesion.

Excision of a Piece of Mucous Membrane.—When the tubercle bacillus is not found in the urine a positive diagnosis may often be made (as suggested by Buerger) by microscopic examination of a piece of mucous membrane removed through the operating cystoscope.

But the localization of the lesion and the establishment of the condition of the opposite kidney require ureter catheterization.

Ureter Catheter Diagnosis.—The catheters are introduced into the renal pelves in order to estimate the presence of retained urine there.

The first urine obtained is discarded in order to avoid contamination with pus that may have been picked up in the bladder.

The next few c.c. are employed for the usual urea and microscopic examination, following which the intravenous phenolsulphonephthalein estimation is made.

In early cases a distinct polyuria from the diseased side will be noted, the increase in quantity being sometimes sufficient to counterbalance the lowered urea percentage so that the total amount of urea secreted at any one time by the diseased kidney is greater than that secreted by the normal kidney. But the phenolsulphonephthalein output is much more markedly interfered with and clearly shows a deficiency on the side of the diseased kidney (only once have I known this to fail; six months later a second cystoscopy showed a distinct, though slight, falling off of phenolsulphonephthalein output, and nephrectomy revealed a destruction of a single papilla by tuberculosis). In these early cases the tubercle bacillus is usually readily identified.

When the disease is further advanced, one recognizes readily enough the presence of pus and the marked lowering, both of phenolsulphonephthalein and urea output. But the identification of the tubercle bacillus may present considerable difficulties. In such cases the excision of a piece of vesical mucous membrane is likely to prove useful.

When the ureter mouths cannot be found, intravenous injection of indigocarmin is a great help, both in suggesting which is the more normal kidney and in aiding the passage of the ureter catheter. Difficulty in cystoscopy, due to the great sensitiveness of the bladder, must

be overcome by various forms of anesthesia. General anesthesia is most inadvisable. The recovery from ether, given for the purpose of cystoscopy, is much more trying and dangerous than when the ether is given for the purpose of nephrectomy; for in the latter case the patient is at least relieved of his toxic focus. I have employed spinal anesthesia with great satisfaction, but have had no luck with sacral anesthesia. My present preference in the management of these cases is to administer hyocin and morphin, then an intravenous injection of indigocarmin, and a local anesthetic. I then employ the 18 F. single catheter cystoscope, direct this immediately toward the ureter mouth, from which I expect to see the blue stream issue; if this appears, catheterize that ureter immediately without looking for anything else; if it does not appear, turn immediately to the other side and catheterize that ureter. By this combination (anesthesia and the use of a small cystoscope) a skillful manipulator can catheterize one ureter with scarcely more pain than would be involved in the introduction of a catheter. Unless the patient is unusually intolerant the cystoscope may be left in place so that through it the water in the bladder can be drawn off as it accumulates for comparison with the urine obtained through the ureter catheter.

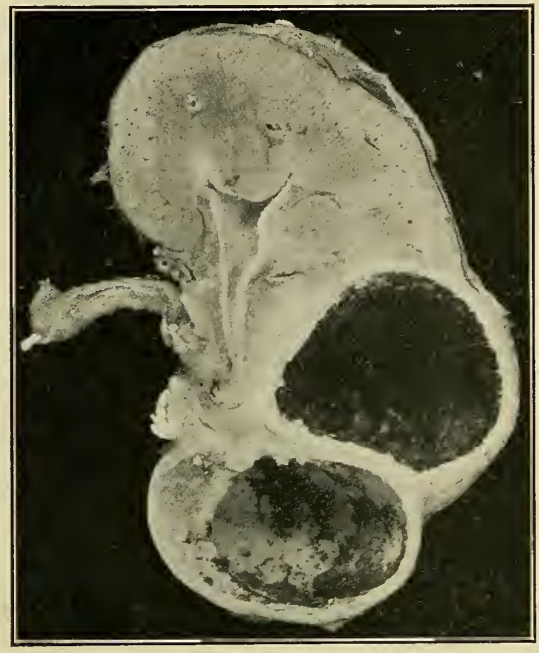


Fig. 93.—Renal Tuberculosis. Remission of symptoms three years (note obliteration of pelvis adjacent to old lesion). Negative guinea-pig. Then recurrence of bladder symptoms. Diagnosis by Fig. 94.

If all these means of diagnosis fail, we must await the guinea-pig for an absolute diagnosis of tuberculosis. Once this is obtained, if there is good reason to believe that one of the kidneys is normal, or relatively normal, the selection of kidney for nephrectomy may be intrusted to exploratory operation. It may be necessary to disclose the surface of both kidneys completely, or even in some instances to palpate both ureters before the diagnosis can be made. A tuberculous kidney always shows a relatively thickened ureter.

Other Means of Diagnosis.—There are many means of diagnosis of secondary importance as confirmatory of the findings enumerated above. Among them the following may be mentioned:

The thickened tuberculous ureter may often be palpated through

FIG. 94.—PYELOGRAM OF FIG. 93. Cystic lower pole shows well, also obliteration of lower half of pelvis and deformity of upper half.

the vagina. (I have once known a competent urologist to feel such a ureter very distinctly when it was not there!)

Pyelography outlines very distinctly the deformity in the kidney pelvis produced by the destruction of tuberculosis (Figs. 93 to 96). But tuberculosis is one of the conditions in which I feel least faith in employing pyelography. The radiogram without pyelography does not

distinguish between the shadow cast by a cheesy kidney and the shadow cast by a hydronephrosis (Pl. XVI).

The tuberculosis complement fixation test for urine is highly spoken of by Heitz-Boyer.[1] I have vainly tried to duplicate his results.

Beer [2] places much dependence upon the diagnostic tuberculin injection to identify the presence of tuberculosis in the body. A focal

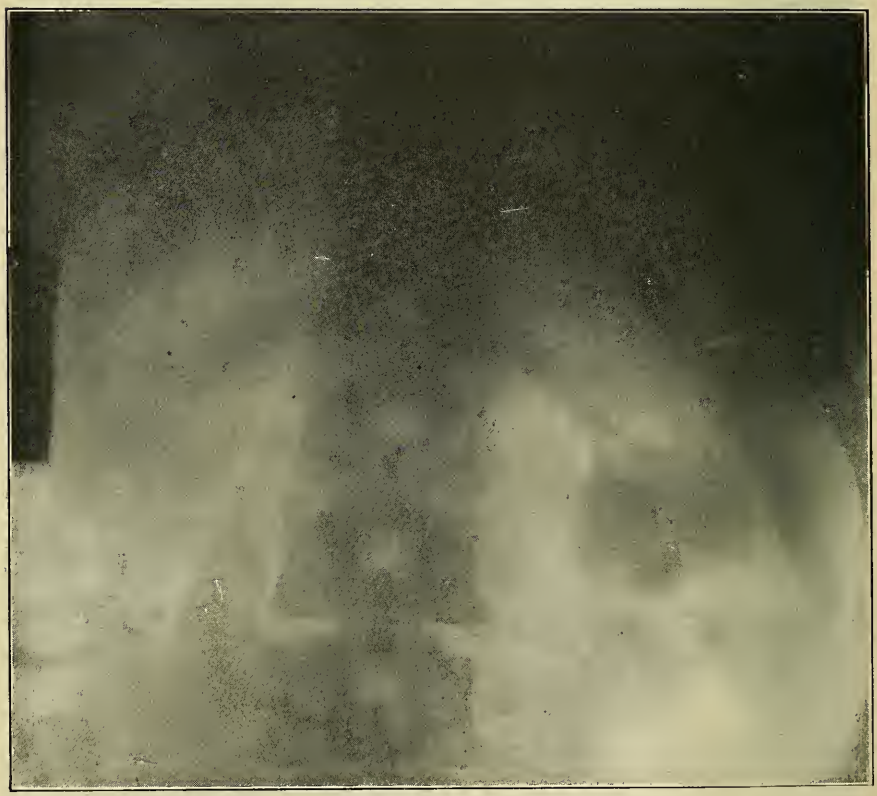


FIG. 95.—PYELOGRAM OF FIG. 96.—Irregular pelvis. Tuberculous ulcerations in parenchyma filled with collargol.

reaction consisting in pain and tenderness (and often an increase of tubercle bacilli in the urine) identifies the situation of the lesion. He believes the drug safe if used with proper restrictions.

PROGNOSIS

The progress of renal tuberculosis may be so rapid that within a few months life is rendered almost unendurable, or the symptoms may remain quite bearable for many years. The general health remains

[1] *Jour. d'Urol.*, Jan. 15, 1912, ii, 71. [2] *Med. Record*, 1913, lxxxiv, 650.

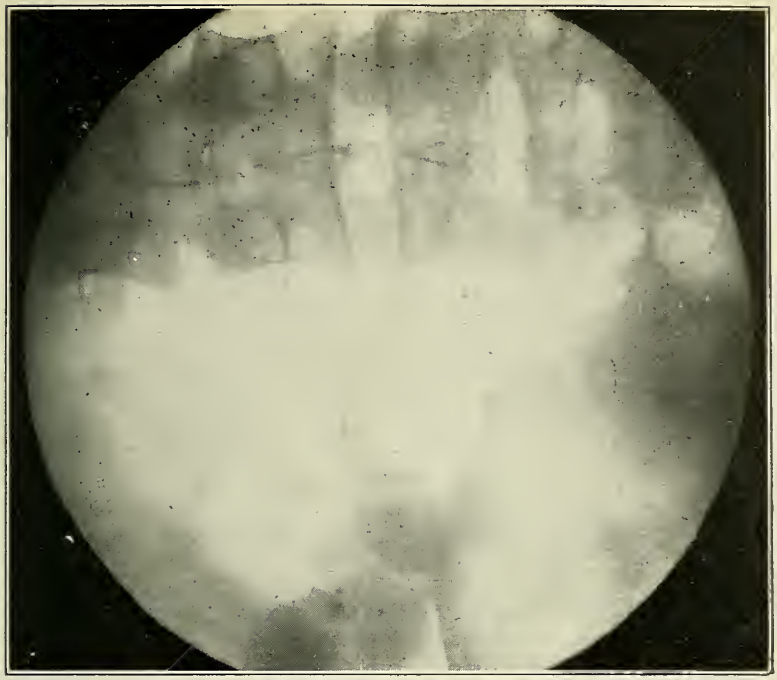


FIG. 1

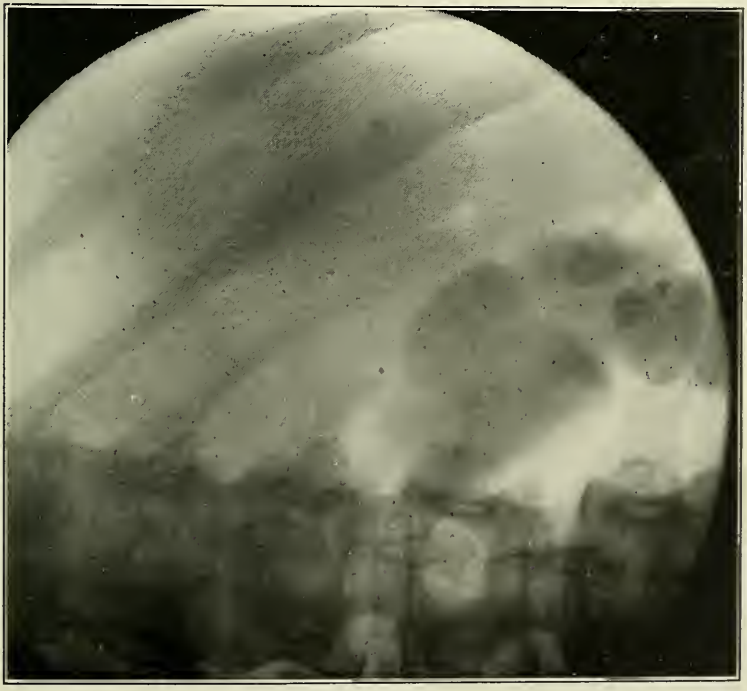


FIG. 2

RADIOGRAPHY OF RENAL TUBERCULOSIS AND HYDRONEPHROSIS.

FIG. 1.—HYDRONEPHROSIS. (Not a pyelogram. The gross specimen removed *after* pyelography is shown in Fig. 39.)

FIG. 2.—CASEOUS RENAL TUBERCULOSIS. (Not a pyelogram.)

good unless retention, bilateral renal lesion or complications impair it. Long periods of remission may occur, but the progress is generally downward. Nephrectomy is the only relief.

Treatment

Wildbolz [1] records his own conversion from medical to surgical treatment in convincing fashion. He cites 78 cases who three years after nephrectomy were divided as follows: 59 per cent alive and cured, 21

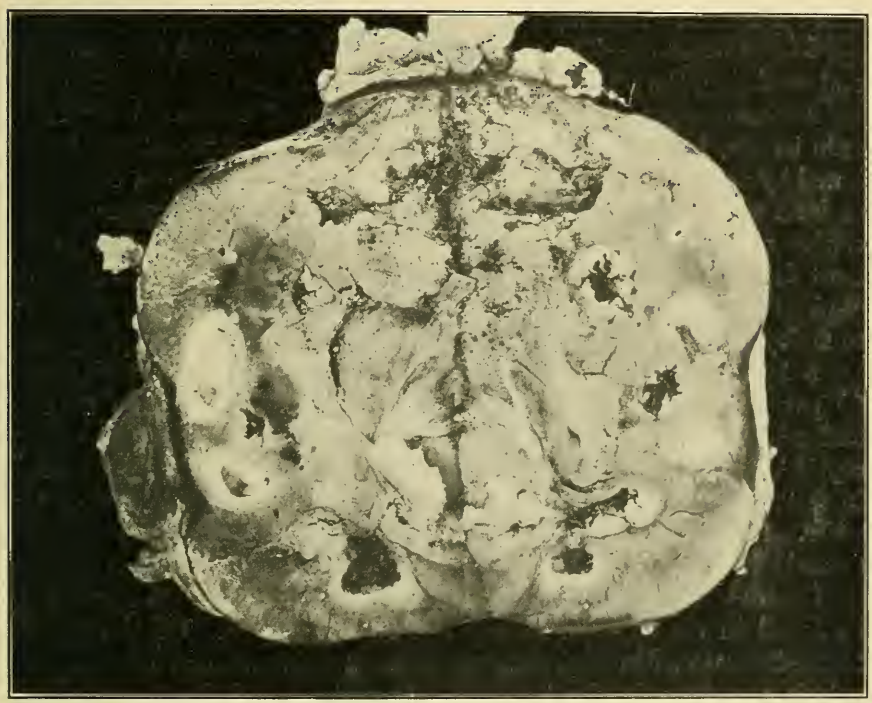


Fig. 96.—Renal Tuberculosis (and Gonorrhea) after Pyelography. Only gonococci had been obtained from this kidney until after pyelography. Then acid-fast bacilli were found.

per cent alive but tuberculous, 20 per cent dead. To compare with these, he collected 316 cases under observation at various sanatoria in Switzerland; 70 per cent of these had died within two years, and of the 98 survivors, 68 still suffered from urinary tuberculosis, while only 30 had been relieved of their symptoms. In 16 of these the clinical cure had persisted for over five years, but after years of apparent cure sudden breakdown and death were known to have occurred.

The classical contribution on nephrectomy for tuberculosis is that of Israel.[1] He collected 1,023 nephrectomies with a mortality of 13

[1] *Correspondenz-Blatt f. Schweitzer Aerzte,* Dec. 20, 1912, xli, 1265.

per cent in the first six months, and as many more later (half of the later mortality occurring in the period between the first six months and the end of the second year, and due chiefly to pulmonary tuberculosis, renal disease, and acute miliary tuberculosis).

The Mayos up to 1912 had performed 203 nephrectomies for tuberculosis with an immediate hospital mortality of 2.9 per cent. Crabtree reports 103 cases from Cabot's clinic with an immediate mortality of 3.8 per cent. I have performed 65 nephrectomies for tuberculosis with 2 deaths before the patients left the hospital, and 3 more during the first six months thereafter.

Aftertreatment.—The aftertreatment must cover the patient's general condition, the persisting tuberculous cystitis and the loin sinus.

Nephrectomy is only the foundation stone of a cure. With it the cure begins, but this will not proceed unless the nephrectomy is followed by an intelligent course of antituberculosis hygiene—a compound of fresh air and overfeeding and the intelligent use of tuberculin. This course may be profitably continued for at least a year, even in the most favorable cases.

The rules for the treatment of tuberculous cystitis—if this continues to annoy the patient—are laid down in the next chapter.

A loin sinus persists for at least two or three months after at least 50 per cent of nephrectomies for tuberculosis. Its healing may be hastened by cutting down granulations and use of the Beer cup. Exceptionally the whole wound will break down and become tuberculous; in this event no complete healing may be expected within one or two years. I have known such wounds to remain open for three years, and to heal at the end of that time. Heroic measures do not hasten healing.

Contra-indications to Nephrectomy.—The contra-indications may be found in the opposite kidney or in other organs. Of the general contra-indications to nephrectomy we need only mention active tuberculosis elsewhere in the body, and myocarditis. I have never been deterred from performing nephrectomy by the fact that the patient's lungs showed signs of apparently healed tuberculosis. Indeed I have once performed nephrectomy successfully under local anesthesia in the face of a rather active pulmonary tuberculosis. In one other case, however, my medical counsel declared the patient's lungs quiescent; I removed a tuberculous kidney, and the patient died a few weeks later of his pulmonary disease. In another case, I braved a mild pulmonary lesion and the patient died five months later.

The condition of the patient's circulation is of the utmost importance. A rapid pulse before operation suggests the possibility of myocarditis, and the propriety of a preliminary week in bed on digitalis. I lost one patient on the third day after operation through myocarditis,

[1] *Folia. Urolog.*, September, 1911, vi.

and have nearly lost several others. Israel regards this as a frequent cause of postoperative death.

The condition of the opposite kidney is also important. It may be congenitally deficient (p. 532), otherwise diseased, the seat of tuberculous nephritis or the seat of active tuberculosis. I have never known tuberculous nephritis to be a valid contra-indication to operation.

Tuberculosis of the opposite kidney was for a long time considered a contra-indication to nephrectomy. This it certainly is not. If there is no great difference between the functional capacity of the two kidneys there is quite obviously no reason to remove either one of them. But if one is gravely infected, the other only slightly involved, the gravely infected kidney should be removed. I have had the happiest results from following this course of action; although I must confess that one of my immediate deaths was the result of an attempt to help the patient by removing a kidney which after all was not much more diseased than its fellow.

But fully half of the cases of bilateral tuberculosis with grave unilateral involvement will not only survive, but will be greatly improved by operation. They may grow fatter than they had been before operation, and may consider themselves practically cured. Their death, when it does come, is likely to come quickly, and as a result of total destruction of the renal parenchyma.

Thus one patient of mine wrote me a letter last June, thanking me for the two years of good health he had enjoyed after taking an equal length of time to recover from his operation; but this man died of renal insufficiency four months later. Another case, one of renal tuberculosis for eleven years before operation, survived the operation four years. At the end of the third year, she weighed more than she ever had in her life, and was all but well. A year later she died very peacefully of renal insufficiency and pulmonary tuberculosis.

To sum up:—The contra-indications to nephrectomy for tuberculosis are:

1. Any general condition contra-indicating a major operation.

2. Active tuberculosis elsewhere in the body in such variety as to contra-indicate a major operation. This includes almost all cases of pulmonary tuberculosis.

3. Tuberculosis of the opposite kidney so far advanced as to impair its phenolsulphonephthalein elimination below 30 per cent, per hour, after intramuscular injection.

4. Any other kidney lesion, congenital or acquired, markedly reducing the function of the kidney.

5. Marked tuberculous nephritis of the opposite kidney or tuberculous myocarditis sufficient to make the pulse persistently rapid are warning signs but not contra-indications to operation.

CHAPTER XLIV

TUBERCULOUS AND SIMPLE ULCERATION OF THE BLADDER—TUBERCULOSIS OF THE PROSTATE AND SEMINAL VESICLES

TUBERCULOSIS OF THE BLADDER

ETIOLOGY

Tuberculosis of the bladder is almost always secondary to lesions in the kidney or in the prostate. It may be secondary to adjacent tuberculosis in other organs. But this is most exceptional. Thus Violer and Chalier [1] report three cases of rupture of tuberculous adnexa into the bladder. At least nine out of ten cases of bladder tuberculosis are secondary to kidney lesions.

Age.—G. Walker [2] collected 475 cases of bladder tuberculosis, the great majority between the ages of 15 and 40.

PATHOLOGY

Distribution of Lesions.—The lesions of vesical tuberculosis begin about the ureter if the disease descends from the kidney; about the bladder neck if the invasion is from the prostate; but when the case is first cystoscoped, there is often a general distribution of the lesions about the trigone, and perhaps about the rest of the bladder, which prevents a definite diagnosis from cystoscopy alone, without the aid of ureter catheterization.

If there is mixed infection, the whole bladder may be inflamed. If not, even though the greater part of the organ is inflamed, there are usually regions in which the normal mucous membrane may be seen at some parts of the vault of the bladder.

The tubercles appear as minute raised areas, the size of a pinhead, surrounded by an area of congestion. They are usually grouped together over irregular areas of the bladder wall, while between them the mucous membrane is red, swollen, and velvety. Thus a diffuse vesical tuberculosis gives the whole mucous membrane a velvety appearance. Although the tubercles may be seen, and sometimes even felt, through the unbroken epithelium, the initial deposit occurs, as Coplin [3] has

[1] *Rev. de. Gynec.*, 1909, xiii, No. 1.

[2] *Annals of Surg.*, Feb., 1907, p. 249.

[3] *Jour. of Cut. and Gen.-Urin. Dis.*, 1898, xvi, 557.

justly remarked, not in the epithelium, but in the subepithelial connective tissue.

The tuberculous ulcer "is singularly round and discoid. . . . Even the confluent ulcers rapidly lose the isthmus which at one time partly separated them and quickly assume a roundish outline. The floor of the ulcer is shaggy, of a dirty yellowish color. It is uneven in contour. . . . Commonly the ulcer does not become larger than 1 or 2 cm., or about the size of a 5-cent piece. The floor of the ulcer is the submucosa containing considerable embryonic tissue. In some instances and at a few points in any ulcer the muscular wall may be exposed. . . . I think extension into the muscular wall must be rather infrequent. . . . The edges are elevated and slightly undermined . . . hard to the touch" (Coplin).

The above description, written from the point of view of the pathologist, is entirely in accord with the clinical findings. I have never known perforation of the bladder to occur spontaneously; but I have twice known perforation to follow cystoscopy. The great irritability of the bladder—its characteristic inability to retain more than a few ounces—is due at first to the great sensitiveness of the tuberculous lesions, later to an actual infiltration and contracture of the muscular walls.

Individual lesions may heal while others progress. The removal of the tuberculous kidney is usually followed by the healing of the tuberculous bladder lesions in a few months if they are recent; in a few years if ancient or fed by tuberculous prostatitis or stricture.

Direct extension of the inflammation to the posterior urethra is common. Extension to the anterior urethra is rare. I have seen it but once. Urethral stricture and periurethral abscess are rare complications.

SYMPTOMS

The symptoms of tuberculosis of the bladder—frequent and painful urination and hematuria, profuse or terminal—and its urinary changes form so essential a part of renal tuberculosis that they have been described in the preceding chapter.

Among the other symptoms due to tuberculous cystitis a partial incontinence of urine from spasm or from ulceration of the neck of the bladder is notable. Stricture of the deep urethra may cause retention of urine. The symptoms of involvement of the other genitourinary organs are sooner or later important.

DIAGNOSIS

The diagnosis of bladder tuberculosis belongs even more intimately with renal tuberculosis than do its symptoms. For the diagnosis of bladder tuberculosis is only interesting insomuch as it leads to a diagnosis of the etiological renal or prostatic lesion.

TREATMENT

The first step in the treatment of bladder tuberculosis is discovery and removal of the offending kidney.

If there is no offending kidney, or if its removal is contra-indicated, or if it has been removed without benefit to the bladder, the direct attack on the bladder begins.

Conservative treatment of tuberculosis of the bladder has given far better results than any of the radical procedures that have been employed. Whatever local or operative treatment be undertaken, hygiene is always the backbone of treatment. Balsamics modify the urine and soothe the bladder. Urinary antiseptics are useless and likely to prove irritating.

Tuberculin injections may relieve the symptoms.

Local Treatment.—Local treatment is employed often with great success, but only according to certain well-defined rules. In the first place, gentleness is more essential here than in any other form of urinary disease. In the second place, irrigations must not be used. They are very badly borne by the sensitive bladder and do no more good than instillations. In the third place, nitrate of silver, boric acid, and permanganate of potassium, so soothing to simple cystitis, cannot be employed in tuberculous cystitis on account of the violent reaction they provoke even in very weak solution—this is especially true of the silver salts. Finally, the best rule for local treatment is to use the drug that gives the most comfort, regardless of any curative powers it may possess.

The best local application for the tuberculous bladder is carbolic acid, as suggested by Rovsing. But his treatment—irrigation with 5 per cent carbolic acid until the fluid returns clear—is unnecessarily painful. As good results may be obtained by daily instillation of two to twenty drops of 2 per cent solution into the bladder neck.

I have also obtained excellent results with instillations of corrosive sublimate. These may be administered daily, 2 to 10 minims to a dose, in very weak solution. Beginning with 1: 25,000, the strength of the solution is increased as far and as rapidly as the patient's symptoms permit. The treatment should excite no sharp reaction.

Collin employs the following:

℞	Pulv. iodoform	1 gm.
	Guaiacol	5 gm.
	Ol. oliv. steril.	100 gm.

Chetwood has used 25 per cent to 100 per cent solutions of guaiacol valerianate in olive oil, and 3 per cent to 12 per cent watery solutions of thallin sulphate. Gomenol is well spoken of.

Surgical Treatment.—If the agony of severe tuberculous cystitis is not relieved by such measures as are detailed above, it may be instantly relieved by lumbar nephrostomy of the remaining kidney.[1]

SIMPLE ULCER OF THE BLADDER

Ulcers of the bladder may be divided into six groups: the traumatic, the inflammatory, the tuberculous, the syphilitic, the malignant and the simple ulcers.

Traumatic Ulcer.—Bladder stone of any size is likely to cause ulceration of the bladder wall, and such ulcerations are very prone to become incrusted. Similar ulcerations may persist for some time after operations upon the bladder, notably after prostatectomy, either giving rise to stone or themselves remaining incrusted. The trauma of parturition not only may result in ulceration of the bladder wall, but may actually cause gangrene.

Inflammatory Ulcers.—These have already been described (page 369). We may enumerate:

1. Ulcerations incident to severe cystitis.
2. Cystitis of the superficial ulcerative type due to mild infection with the pyogenic cocci.
3. Ulcers of the type described by Hunner (see below).
4. Incrusted ulcers.

Tuberculous Ulceration.—These have been described as forming a part of tuberculous cystitis (see page 432).

Syphilitic Ulcers.—Muscharinksi [2] has collected the data of 9 cases of syphilis of the bladder diagnosed at autopsy, 6 cases diagnosed by the success of treatment, and 19 cases diagnosed by cystoscopy. The array is a formidable one, but the documents are not particularly convincing. The lesions described are papular, ulcerative, and neoplastic in type. They cause pyuria, frequency of urination, hematuria, and retention of urine. That syphilis of the bladder may exist cannot be denied, but it must be very rare. The clinicians who attribute conditions seen by them in the bladder to syphilis, seem rather credulous. I have personally encountered but one case in which a colleague saw a syphilitic ulcer of the bladder, and cured it by injections of salicylate of mercury; thereby checking the hemorrhage which was the patient's only symptom. But the hemorrhage returned after a few months, and this time a nephrectomy for carcinoma was required to stop it!

Carcinomatous Ulcer.—Certain carcinomatous ulcerations very closely resemble the type of ulcer that becomes incrusted (p. 504).

[1] Cf. Boeckel, *Jour. d'Urol.*, Mar. 15, 1912, i, No. 3.

[2] *Zeitschr. f. Urol.*, 1912, vi, 5.

Simple Ulcer.—Simple ulcer of the bladder is quite as doubtful a clinical entity as is syphilitic ulcer. Among the more important contributions to the subject may be mentioned those of Hurry Fenwick,[1] Gaudiani,[2] and Buerger.[3] (See also p. 370). The lesion described by these and other authors is apparently the incrusted ulcer. The lesion has been compared to ulcer of the stomach, and is said sometimes to cause perforation. Its actual origin is doubtless inflammatory, and its gravity due as much to the irritation of the phosphatic incrustation as to anything else. The ulcer may be single, as Hurry Fenwick says it always is; I have several times seen multiple ulcers, however. Fenwick thinks they usually appear in the region of the ureter orifice; my impression is that they rather tend to cluster round the urethra and trigone.

The treatment of these simple ulcers, like that of the inflammatory ulcers, depends upon the gravity of the lesion. A slight lesion may be cured by the instillation of strong chemicals into the bladder. Buerger has cured incrusted lesions by excision with his operative cystoscope. I have both succeeded and failed with this instrument. I confess to a preference for argyrol, carbolic acid, and the acidophilus bacillus as local applications. I have cured an incrusted ulcer in a woman by curettage through the urethra. Suprapubic section, even with curettage, cauterization, or actual excision of the ulcer, gives no guarantee of a cure if the ulcer is incrusted. One can hope for a cure only by getting rid of the infection with pyogenic cocci.

Hunner [4] has called attention to a very chronic type of ulcer of the bladder vault of young women. Cystoscopically it looks superficial, but it may involve the whole thickness of the bladder wall. The only sure cure is wide excision.

TUBERCULOSIS OF THE PROSTATE

Tuberculosis of the prostate is the central point, as it were, of genito-urinary tuberculosis. Whether or not the prostate is the site of the original lesion of genital tuberculosis, it is through the prostate that tuberculosis of the urinary tract reaches the genitals, and vice versa, and it is through tuberculosis of the prostate that the inflammation crosses from one testicle to the other.

[1] *British Med. Jour.*, 1896, i, 1133; "Ulceration of the Bladder," London, 1900.
[2] *Folia Urol.*, 1910, iv, 738.
[3] *Med. Record*, April 12, 1913.
[4] *Trans. N. E. Branch of Am. Urol. Assn.*, 1914-15, p. 11.

ETIOLOGY

Those who consider tuberculosis of the prostate a primary lesion (cf. p. 580) find its chief cause in chronic gonorrheal prostatitis. Sexual excess, calculus, etc., have been incriminated, and in some cases the disease has evidently nothing to do with previous inflammation. Like other tuberculous manifestations, it is commonest in the young adult of a tuberculous predisposition. I cannot accept infection *in coitu.*

PATHOLOGY

Tuberculization always begins just beneath the glandular epithelium. It goes through the ordinary stages of caseation, abscess formation, and fistulization, or it may terminate by cicatrization.

Although the tuberculous prostate may show no lesions palpable by rectal touch, the disease is usually bilateral, rarely or only for a brief space confined to one half of the gland. It invades every part of the gland, including the posterior lobe.

When abscess forms it usually bursts into the urethra. I have known but three to open posteriorly. The tuberculosis spreads to the posterior urethra and bladder.

SYMPTOMS

The disease begins in one of four ways:

1. It is secondary to a chronic posterior urethritis, assuming its specific characteristics imperceptibly, and patient and surgeon are often unaware of the change until rudely aroused by some of the typical manifestations of tubercle in bladder or epididymis.

2. It is apparently spontaneous. The patient comes complaining of gleet or dysuria for which he fails to account.

3. It is a minor feature of an epididymal infection. The patient complains of the enlarged testicle, and is not aware of the shreds or pus in his urine that testify to the prostatic inflammation.

4. Less frequently a spontaneous hematuria or a urethrorrhagia is the first sign of the disease.

The prostate may be tuberculous for many years and yet give no symptom. When symptoms arise they are due to ulceration of the posterior urethra and bladder neck and are precisely those of tuberculous cystitis.

DIAGNOSIS

Until periprostatic suppuration bursts, and leaves a rectal or perineal tuberculous fistula, we have no pathognomonic clinical sign of

tuberculosis of the prostate. When the epididymis or the bladder is known to be tuberculous, and the prostate found to be swollen or nodular, we conclude properly enough that it is the seat of tuberculosis. But in the absence of these adjacent lesions the prostate itself gives no characteristic sign of the disease. It may be tuberculous and yet show no palpable change; it may be indurated in an irregular manner, suggestive of tuberculosis, and yet not be tuberculous.

The prostate, like the epididymis, is subject to acute nongonorrheal infection very suggestive of tuberculosis, from which indeed it is usually distinguished only by the absence of the tubercle bacillus and the spontaneous cure of the acute prostatic infection.

PROGNOSIS AND TREATMENT

Although prostatic tuberculosis may protract the duration of bladder tuberculosis after the removal of the offending kidney, this type of tuberculosis, nevertheless, usually gets spontaneously well under hygienic treatment.

The usual type associated with unilateral or bilateral tuberculosis of the epididymis and seminal vesicle may be depended upon to get well with epididymectomy and hygiene.

Exceptionally, however, the prostatic and vesicular lesions persist, and cause grave stricture of the urethra, periurethral abscess, and persistent tuberculous cystitis. Under these circumstances, operation is justifiable with the object of removing the seminal vesicle and more or less of the prostate.[1] This operation is justified only by persistent and intractable lesions. It may result in a brilliant success, but is rather more likely to result in large tuberculous perineal fistula with complete incontinence of urine. Sufficient experience has not accumulated to determine whether in these desperate cases it is wiser to perform this operation or ureterocolostomy.

VESICULAR TUBERCULOSIS

Tuberculosis of the vesicle is always at first unilateral. Before both vesicles are affected the prostate must become inflamed. Whether tuberculosis is usually primary in the prostate or in the vesicle is not clear.

The lesions of localized tuberculosis—tuberculization, caseation, and suppuration terminating in fistula or atrophy—appear first near the mouth of the organ, where they may remain localized or whence they may be disseminated throughout its length.

[1] Cf. Keim, *Rev. Prat. d'Obstet.*, 1913, xxi, 10.

SYMPTOMS

Commonly there are no symptoms directly referable to the vesicle. Hemospermia, abscess, fistula, increase or decrease in the sexual appetite —all these are rare. In most cases there is simply evidence of a tuberculosis of the prostate or of the epididymis, and examination reveals the condition of the vesicle. Simmonds [1] examined 25 cases of tuberculous vesiculitis post mortem and only 6 of these were found to be sterile.

DIAGNOSIS

When the prostate or epididymis is known to be tuberculous and the vesicle is found dilated or nodular it may be assumed to be tuberculous as well.

On the other hand, when there is doubt as to the nature of the prostatic inflammation an examination of the vesicles may sometimes throw some light upon the subject. If typical hard nodular areas of tuberculization are encountered they at once establish a diagnosis. But more often the organ is merely dilated in a manner suggestive of simple inflammation. If, in such a case, the urinary and physical examinations fail to indicate the nature of the disease, the latter may declare itself in a characteristic but disagreeable fashion by an outburst of tuberculous epididymitis directly referable to the examination of the vesicle. Hence the rule: *never massage or examine a suspected tuberculous vesicle except with the lightest possible touch.*

TREATMENT

All local treatment of a palliative sort must be studiously avoided. Massage and douching do not benefit the vesicle, but endanger the testicle. Here, as elsewhere, the general hygienic treatment of tuberculosis is of prime importance.

Surgical Treatment.—Inasmuch as tuberculosis of the seminal vesicle and prostate is unquestionably kept active by the presence of tuberculosis in the epididymis, there can be no question of the advisability of removing the epididymal focus as soon as the diagnosis is certain.

On the other hand, it is quite obviously absurd to expect to amputate tuberculosis of the epididymis or of the testicle, and thus to get rid of all the tuberculosis in the body. In fully half of the cases the opposite testicle will become involved no matter what operation is performed, unless the patient submits to prolonged treatment by hygiene and tuberculin after the operation.

[1] *Deutsch. Archiv f. klin. Med.*, 1898, lxi, 412.

In a number of patients I have examined the semen before operation, found it sterile, and at the time of removing a single epididymis I have divided the opposite vas. None of these patients has, so far as I know, had an infection of the opposite epididymis. This is a prophylactic measure worthy of consideration.

Vesiculectomy for tuberculosis gives most discouraging results.

CHAPTER XLV

MOVABLE KIDNEY

The kidney is naturally endowed with a certain degree of mobility. Like the other abdominal viscera it moves with respiration and its position is influenced by the attitude of the subject. Yet this condition is entirely normal. Such a kidney is not distinctly palpable. A movable kidney, on the other hand, is one that is subject to downward displacement to such an extent that it may be distinctly palpated by the usual methods of examination. Continental writers distinguish mobility of the first degree (the fingers can grasp the kidney), the second degree (the fingers can be brought together above the organ), and the third degree (the kidney can be depressed into the iliac fossa).

FREQUENCY

The recorded frequency of movable kidney varies with the point of view of the author and the delicacy of his sense of touch. The widely divergent opinions of various writers may be tabulated thus:

	Women.		Per Cent.	Men.		Per Cent.
	Cases Examined.	Movable Kidney.		Cases Examined.	Movable Kidney.	
Bergmann[1]	905	40	4.41	828	4	0.48
Einhorn[2]	543	112	20	772	14	1.81
Idem[3]	832	240	28	1,080	42	3.88
Mathieu[4]	306	85	25	...	..	....
Godard-Danhieux[5]	603	212	35	268	6	2.33
Suckling[6]	100	42	42	100	6	6
Harris[7]	126	71	56	...	..	....

[1] *Op. cit.*, p. 134.
[2] *Med. Record*, 1898, liv, 220.
[3] *Ibid.*, 1901, lix, 561.
[4] *Le bull. méd.*, 1893, vii, 1113.
[5] *Guyon's Annales*, 1901, xix, 197.
[6] *Edinb. Med. Jour.*, 1898, iv, 228.
[7] *Jour. of the Am. Med. Assn.*, 1901, xxxvi, 1527.

Many of these statistics are obviously compiled in *camera,* and represent only the physician's interpretation of the term "movable kidney" without any reference to the patient's symptoms. The average observer will probably recognize a movable kidney in 20 per cent of women and 2 per cent of men; yet the cases which have symptoms and require treatment are far fewer than this.

There is a general agreement that in 8 cases out of 10 the right kidney only is movable; of the remainder the majority are bilateral, unilateral left-sided nephroptosis being most unusual. When both kidneys are movable, the right kidney is usually more movable than the left.

Although movable kidneys have been discovered in patients of all ages, the symptoms of the disease appear in the third decade of life and disappear between the fortieth and fiftieth years.

PATHOGENESIS

To be satisfactory, a theory must explain (*a*) the predominance of movable kidney in woman, (*b*) the frequency with which it occurs on the right side, and (*c*) its importance between the ages of twenty and forty.

We shall consider:

a. Causes of congenital nephroptosis.

b. Causes of acquired nephroptosis.

Primary predisposing cause.—Shape of the lumbar recess.

Secondary predisposing cause { Enteroptosis. Pregnancy. Emaciation.

Exciting causes { Corsets. Trauma.

a. **Causes of Congenital Nephroptosis.**—The existence of congenital nephroptosis has been doubted, but the possibility of such a condition is proved by such cases as Dr. W. R. Stewart's. In this case an exploratory operation performed for intestinal obstruction on an infant eight months old disclosed a floating kidney. Abt [1] and Morris have collected similar cases. Yet the discovery of a movable kidney in a child is undoubtedly exceptional, and the occurrence of any symptoms before puberty is rarer still.

With our present knowledge it is impossible to say what may be the cause of this condition. It has not been determined how far the factors that operate in later life are at work, and how great a part actual abnormal development plays. Coffey,[2] however, states that "a unilateral

[1] *Jour. of the Am. Med. Assn.,* 1901, xxxvi, 1166.

[2] *Surg., Gynec. and Obstet.,* 1912, xv, 381.

right movable kidney is almost never seen except in cases where there has been a deficient peritoneal fusion of the ascending colon and mesocolon with the parietal peritoneum in front of the kidney."

b. **Causes of Acquired Nephroptosis.**—Primary Predisposing Cause.—Wolkow and Delitzen [1] have shown by an extensive series of pathological investigations that there is quite a wide variation in the size of the niche in the loin occupied by the kidney. The paravertebral niche, as they call it, is shallower in women than in men, shallower on the right side [2] than on the left. The feminine peculiarity appears with the broadening of the pelvis at the advent of puberty; and it is this feminine, right-sided shallowness of the bed in which the kidney lies that is the chief predisposing cause of nephroptosis. Harris has gone even further, and maintains that the chief characteristics of the body form that predispose to nephroptosis "are a marked contraction of the middle zone of the body with a diminution in the capacity of this portion of the body cavity. This diminution in the capacity of the middle zone depresses the kidney, so that the constricted outlet of the zone comes above the center of the organ, and all acts, such as coughing, straining, lifting, flexions of the body, etc., which tend to adduct the lower ribs, press on the upper pole of the kidney and crowd it still farther downward. It is the long-continued repetition, in a suitable body form, of these influences, which collectively may be called internal traumata, that gradually produces a movable kidney."

Secondary Predisposing Causes.—The internal traumata just mentioned, and many others, such as intermittent renal congestion during menstruation, prolapse, and inflammation of the pelvic organs, etc., may be included here; but we need discuss only four alleged causes—viz., enteroptosis, weakness of the abdominal wall, pregnancy, and emaciation.

Enteroptosis is a general condition, of which nephroptosis is often one of the features. Glenard [3] considers that nephroptosis never exists without a general enteroptosis, but he stands alone in this opinion. Einhorn [4] has seen 27 cases of enteroptosis without nephroptosis, and 213 cases in which both conditions existed; hepatoptosis occurred with nephroptosis only 30 times, 54 times without it; while in 57 cases only the kidney was movable. Similarly Godard-Danhieux [5] records 131 cases of nephroptosis without enteroptosis, and 81 cases with it; while in 97 instances there was enteroptosis without nephroptosis.

Modern radiography has, however, shown coloptosis to be much

[1] "Die Wanderniere," 1899, Berlin.

[2] Chiefly because the liver fills the upper segment of the niche on this side.

[3] "Les Ptoses viscérales," Paris, 1899. *Lyon méd.*, 1885, xliv, 8.

[4] *Med. Record*, 1898, liv, 220; 1899, lvi, 397; and 1901, lix, 561.

[5] *Gaz. hebd.*, 1900, v, 159.

more common than had been supposed, and the tendency is once again to attach nephroptosis to general enteroptosis by means of the nephrocolic ligament, a band leading from the hepatic flexure to the lower pole of the right kidney.[1]

Pregnancy introduces another dispute. It is an accepted fact that repeated pregnancies favor relaxation of the abdominal wall and enteroptosis, yet there is an absolute disagreement in the statistics on nephroptosis. Landau, Senator, Moulin, Morris, and others maintain that movable kidney is more frequent in women who have borne children, while Küttner, Godard-Danhieux, and Lindner defend the opposite theory.

Weakness of the abdominal wall, Wolkow and Delitzen insist, is a strong predisposing factor in enteroptosis and nephroptosis. The abdominal viscera are deprived of their necessary support, and therefore sag downward, carrying the kidneys with them, in case the shallowness of the paravertebral niches makes these organs liable to prolapse.

Emaciation, it is stated, causes nephroptosis by absorption of the perirenal fat. Morris has often noted the small quantity of fat that surrounds kidneys requiring nephrorrhaphy. Yet one can scarcely believe that the absorption of fat could be so sudden as to leave a space into which the kidney would sag. On the other hand, it is quite conceivable that the excursions of a movable kidney should discourage the deposition of fat within its fascial envelope.

Exciting Causes.—*Corsets* have been alternately praised and condemned. A corset that brings pressure to bear below the kidney region will, if applied while the kidney is in place, help to retain a movable organ; while a long-waisted corset that compresses the ribs is equally likely to encourage renal mobility. The fact that Egyptians suffer from movable kidney is evidence that the corset does not deserve all the blame which has been heaped upon it. Yet it does weaken the abdominal wall and so increases the liability to nephroptosis.

Position is justly blamed by Cabot and Browne, who maintain that the drooping, flat-chested, round-shouldered attitude compresses the lower ribs and is the occasion of many cases of renal mobility.

Trauma of one sort or another is certainly the exciting cause of all cases of movable kidney. But it is equally certain that the trauma in question is usually of a mild type. Suckling mentions the influence of constant stooping. The internal traumata recognized by Harris have been enumerated. The influence of pregnancy and corsets has already been mentioned. Bergmann insists upon the evil effect of horseback riding.

The effect of acute trauma, such as falls, kicks, and blows, is an open question. Harris absolutely denies its influence, and though many acute

[1] Cf. Longyear, "Nephrocoloptosis," 1910.

cases from this cause have been enumerated, I believe that in most instances the trauma has been only the cause of symptoms in an organ already movable.

Secondary Changes.—As a result of long-continued mobility the *renal vessels* may become considerably lengthened. They are the radii of the circle in which the kidney moves; as they lengthen mobility increases.

The *ureter* may become kinked, and in this event, which is by no means uncommon, the free outflow of urine is obstructed, renal colic ensues, and the kidney becomes inflamed or hydronephrotic.

Adhesions may form as a result of repeated attacks of hydronephrosis or of other inflammation of the kidney itself or of surrounding tissues. Such adhesions increase the ureteral obstruction.

The *kidney* itself may be misshapen through pressure, or inflamed or hydronephrotic.

Exceptionally *gangrene of the kidney* has occurred from torsion of the pedicle.

SYMPTOMS

So as to bring order out of the contradictory opinions concerning the symptoms of movable kidney, we may take as the basis of our description a few commonly accepted facts. *In the first place,* any surgeon familiar with abdominal palpation appreciates that, in examining a patient, one occasionally finds a movable kidney which has never given any symptoms, and of whose existence the patient will not become aware unless the surgeon announces his discovery. *A second class* of cases, while having a movable kidney and suffering from various symptoms—digestive, neurotic, or pelvic—have no symptoms directly referable to the kidney itself. The organ is neither tender, adherent, nor enlarged. There is no history of hydronephrosis, no evidence of either urinary infection or renal sclerosis. *Finally,* there are other cases with symptoms directly referable to the kidney itself. Thus nephroptosis is encountered clinically under three aspects:

1. Nephroptosis without symptoms.
2. Nephroptosis without symptoms directly referable to the kidney.
3. Nephroptosis with symptoms directly referable to the kidney.

Nephroptosis without Symptoms Directly Referable to the Kidney.—The greater number of cases commonly classed as movable kidney come under this head, and it is the infinite variety of symptoms which such cases present, the doubtful origin of these symptoms, and the uncertainty of their cure, that has obscured the whole subject and given rise to opinions so divergent and to discussion so virulent.

The class of cases under discussion has but two common features:

(1) The subjective symptoms are referable to any one of several diseases of organs other than the kidneys, and (2) one or both kidneys are movable, but present no signs, either subjective (pain) or objective, of disease. Such patients may present nervous symptoms, digestive disorders, or painful symptoms. These symptoms are exhibited in greater or less degree and in various combinations.

Nervous Symptoms.—It is quite impracticable to detail here the various symptoms of neurasthenia with abdominal manifestations that have been attributed to renal mobility. Their name is legion. But the question that always arises is: Does the neurasthenia depend upon the movable kidney? Two answers may be suggested. If temporary reposition of the affected organ by dorsal decubitus brings temporary relief from the symptoms, and if with renewal of the kidney prolapse the symptoms recur, there is, clinically speaking, an established connection between the mobility of the kidney and the nervous symptoms. In the second place, it may be found that there is nephritis or renal infection. In this case the nervous symptoms may possibly be attributed to renal autointoxication.

Digestive Disorders.—The flatulent dyspepsia and constipation that figure so prominently among the symptoms of nephroptosis are but rarely referable to the kidney. Einhorn's opinion upon this subject deserves quotation:

> Most of the gastric and intestinal symptoms, such as pains, eructations, nausea, occasional vomiting, irregularity of the bowels (chiefly constipation, somethimes diarrhea), which are present in persons with movable kidney, occur usually independently of the latter, and require therapeutic measures appropriate to such conditions.

Here, again, the tests applied to neurotic cases are of service. If lying down relieves the symptoms, or if there is renal insufficiency, some connection between the renal condition and the digestive disturbance may be suspected.

We may mention here the theory originated by Edebohls[1] that movable kidney on the right side may cause chronic appendicitis by pressure upon the superior mesenteric vein.

Painful Symptoms.—The pains most often caused by movable kidney are: (1) Pain and tenderness in the kidney itself; (2) pain of a dull, dragging character low down in the back, a pain comparable to that commonly attributed to uterine retrodisplacement; (3) frequent and painful urination. It is characteristic that these pains should be increased by exercise, and should be more severe during the menstrual period. Any of them may be attributable to conditions other than nephroptosis. Therefore it is essential that they should be

[1] *Post-Graduate*, 1899, xiv, 85.

known to disappear with reposition of the kidney, and to reappear with its prolapse before we can be sure of any connection between the pain and the renal mobility.

Nephroptosis with Symptoms Directly Referable to the Kidney.—Here we enter upon a more definite field of investigation. If the kidney is tender and painful, if the tenderness is relieved by reposition of the organ, if there is renal colic, or if the tender kidney is enlarged

Fig. 97.—Movable Kidney Injected with Argyrol. Patient had had a Dietl crisis. Injection shows absence of hydronephrosis.

or adherent in an abnormal position, we have direct physical evidence that the symptom is due to the nephroptosis. Even more characteristic is the *intermittent hydronephrosis* (cf. p. 460) due to movable kidney. It is usually very painful, and its growth is often attended by *renal colic* (Dietl's crisis), rarely by profuse *hematuria*.

Renal infection may also complicate mobility.

Lillienthal [1] has reported two cases which he interprets as torsion of the kidney.

DIAGNOSIS

If the kidney is only slightly movable this may be detected by ballottement. A floating organ may be discovered almost anywhere in the

[1] *Am. Jour. of Dermatol.*, 1912, xvi, No. 5.

abdomen. As a rule, it is not difficult to distinguish a floating kidney from other abdominal tumors. The very mobility of the organ, the fact that it may be replaced in the loin, together with its general contour, and the sickening sensation, similar to and yet not the same as the ovarian sensation, caused by pressure upon it, are sufficiently characteristic. Tumors arising from the ovaries or uterus may be distinguished by their pelvic attachments. To distinguish a movable kidney from a distended gall-bladder, or a corset-lobe of the liver, we sometimes have to resort to pyelography.

But the discovery of a movable kidney by no means completes the diagnosis. It is equally important to ascertain whether the symptoms are due to the nephroptosis or to something else. In some cases there can be no doubt that the kidney is at fault. If a hydronephrosis, a pyonephrosis, or an adherent organ is discovered, here is a pathological condition demanding treatment. Then there are the tender kidneys and those cases whose symptoms are temporarily relieved by rest and reposition of the displaced organ. These form a doubtful class, and merit the most minute examination and the closest watching, of which the palliative treatment of the disease forms an important part. The majority of them are complicated by some neurotic tendency, enteroptosis, or gastro-intestinal or pelvic disease. Their judicious treatment is peculiarly difficult. Finally, there are the cases in which no test can show a direct connection between the renal ptosis and the symptoms.

TREATMENT [1]

In deciding upon the proper course of treatment for any individual case of movable kidney, the surgeon must bear in mind the following facts:

1. In many cases nephroptosis produces no symptoms.

2. In many instances nephropexy, while it retains the kidney in place (which it does not always do), either fails to relieve or aggravates the neurotic or dyspeptic symptoms attributed to renal mobility.

In view of these facts we must hesitate to elect nephropexy, a treatment which, though surgically a success, may prove clinically a failure, or worse than a failure. Mechanical treatment—supporting the kidney by a suitable belt—may always be experimentally employed in doubtful cases. But to have recourse to surgery is a grave matter. Not because of the danger or discomfort connected with the operation, for the former is almost nil, the latter inconsiderable, but because in most instances the patient is distinctly neurotic, and, while the influence of the opera-

[1] An exhaustive review has been published by Scheuermann (*Archiv f. klin. Chir.*, 1914, civ, No. 1).

tion *per se* may be beneficial, it may also be injurious. In short, the knife is no proper instrument for a faith cure. Its brilliant successes should not blind us to its failures. Yet where palliative measures fail, and the symptoms are apparently dependent upon the renal mobility and require relief, there is no choice. An operation is then surely the lesser evil. So we may conclude that *the treatment of subjective symptoms due to renal mobility is palliative; surgical measures should be reserved for the treatment of kidneys showing definite pathological lesions, and for those cases that do not respond to persistent, intelligent palliative treatment.*

Palliative Treatment.—The broad lines of palliative treatment are the following:

1. To remedy digestive and menstrual derangements.
2. To correct position and avoid overfatigue.
3. To improve the general vitality and combat neurasthenia by overfeeding, massage, hygiene, and tonics, and
4. To apply an abdominal supporter.

Much emphasis is placed upon the kind of belt or corset employed to support the abdomen. Edebohls [1] reviews the opinions of various writers upon this subject, even to that of Gurtzburg, who "administers a yeast ferment with the object of producing meteorism, and thus sustaining the prolapsed kidney." This is an extreme example of the fallacious impression that a support must be worn solely for the purposes of retaining a kidney in place, and that, this accomplished, the cure is assured. Nothing could be further from the truth. As a matter of fact, it is the patient's general condition that should be attacked primarily, the local condition only secondarily. Many a case of "movable kidney" is cured by hygiene, diet, and exercise, while the kidney remains as loose as ever. Moreover, in applying a belt or a corset the effort must be made to support all the abdominal viscera, not the kidney only. It is not conceivable that any form of pad should hold the kidney in place, and therefore it is wiser to dispense entirely with pads and to support the abdominal contents *en masse*. For this purpose the modern straight-front corset may be employed. Some women find that this, if applied in the recumbent position, acts as an admirable supporter.

The backbone of the non-operative prevention and cure of the symptoms of nephroptosis is a course of orthopedic training in proper position. The patient must learn to stand and walk touching the clouds with the crown. "Chest out, and everything else—chin, abdomen, lips, toes—in," must be the rule. Such an attitude makes room for the solid viscera under the diaphragm and relieves many patients.

Surgical Treatment.—Nephropexy (nephrorrhaphy) is the operation of fixing the prolapsed kidney against the abdominal wall.

[1] *Med. Record*, 1901, lix, 690.

Results of Nephropexy.[1]—The earlier nephropexies were so uniformly followed by relapse that many physicians opposed the operation on the ground that a permanent cure was *never* accomplished by operation; but recent statistics tell an entirely different story. Morris has performed 98 nephropexies with 1 death ("cardiac thrombosis in a stout female whose kidney was incised and explored before being fixed"), and only "a few" relapses after operations performed according to "a plan different from the present methods." Edebohls reports 193 cases (68 bilateral), with 3 deaths and 2 known relapses. All of my own cases have been successful.

But nephropexy may be regarded from another point of view. In a very considerable proportion of cases the patients have complained of more pain after the operation than before. This may be due to one of several factors: perhaps the pain did not commence in the kidney, and therefore was not relieved by operation, but was rather intensified by the shock and disappointment; or perhaps it was due to adhesions or kinks of the ureter which were not relieved by the surgeon; or perhaps the kidney was replaced high up in the loin in a niche from which it had descended because there was not sufficient room for it (Harris). However this may be, I have had only one patient complain of a recurrence of pain. Nephropexy was performed upon her as a lesser evil than exploratory abdominal section, with which she was threatened by another surgeon. Her various neurotic symptoms, which had existed for years, immediately disappeared. Five years later they returned, and she underwent at the hands of various surgeons the extraction of several teeth, drainage of the antrum of Highmore, excision of the inferior dental nerve, nephrectomy (the kidney was found firmly adherent), vesicovaginal fistulization, an infinite variety of other treatments, all to no avail. It has been interesting to find two reports of her cure, the one by a dentist, the other by a physician who inflated her colon with carbonic acid gas. Finally, exploratory laparotomy was performed a year ago. A normal appendix was removed—and she has remained better ever since, though far from well. She has been poisoned by a rectal injection of boric acid, but survived!

[1] Cf. Scheuermann, *Archiv f. klin. Chir.*, 1914, civ, No. 1.

CHAPTER XLVI

THE URETERS AND THEIR DISEASES

ANATOMY

The ureter is the excretory duct of the kidney. It is a fibromuscular tube beginning at the funnel-shaped neck of the renal pelvis and terminating at the lateral angle of the trigone of the bladder. There is normally one ureter for each kidney. Each ureter is from 25 to 30 cm. long. The ureter is, when empty, a closed tube like the urethra. Its physiological caliber is that of a cylinder about 0.3 cm. ($\frac{1}{8}$ inch) in diameter. The lumen of the ureter is slightly constricted at four points: (1) A distinct narrowing at a point about 2 cm. from its upper extremity, (2) a slight narrowing where it crosses the brim of the pelvis, (3) a muscular constriction at its entrance into the bladder wall, and (4) at the vesical orifice.

Structure.—The ureter is composed of three coats: the fibrous, the muscular, and the mucous.

The *fibrous* external coat runs continuously from the fibrous envelope of the kidney and its pelvis to the bladder. It is a tough, glistening, elastic tissue.

The *muscular* coat consists of an external longitudinal and an internal circular layer of smooth muscle. It is well developed in both the ureter and the pelvis of the kidney. In the calices it thins out to a few stray fibers. At the vesical extremity of the ureter its muscle pierces that of the bladder and is continued as a band of fibers running along each edge of the trigone. Thus there is one band joining the two ureters (interureteric muscle) which sometimes raises a distinct transverse fold in the mucous membrane, while another thinner band of fibers runs from each ureter toward the neck of the bladder. The ureter possesses no proper sphincter. Its power of resisting regurgitation from the bladder is due to its oblique course through the muscular wall of the bladder, and to the constriction of the bladder muscle, which automatically closes the ureteral orifices as it contracts to force the urine into the urethra.

The *mucous membrane* of the ureter is smooth and thrown into longitudinal folds when the organ is collapsed. The epithelium consists of

several superposed layers, the deeper ones conical or ovoidal, the superficial ones cuboidal or flattened. Though some expert microscopists claim to be able to distinguish the epithelium of the pelvis of the kidney from that of the ureter, most conservative observers confess their inability to make such a distinction, and do not even venture to assert that any given cells in the urine come from any part of the ureter or its pelvis unless the presumption is confirmed by other signs, notably the presence of renal casts and albumin.

Relations.—The ureter lies immediately behind the peritoneum throughout almost its whole length. It is firmly attached to this structure, so that when the peritoneum is detached from the parietes the ureter is carried with it. When this dissection is performed by the finger the ureter may be identified as a cord interrupting the smooth yielding surface of the peritoneum within 3 cm. ($1\frac{1}{2}$ inches) of the spinal column. In the abdomen the ureter lies upon the psoas muscle and crosses the genitocrural nerve. It is in turn crossed by the spermatic (or ovarian) vessels. On the right side it lies close to the vena cava. At the brim of the pelvis it crosses the common iliac vessels at or near their bifurcation. Thence it plunges down in a fold of peritoneum (posterior false ligament of the bladder), passes under the arch of the vas deferens, external to it, entering the bladder wall close above the seminal vesicle and about 2 cm. from the median line. Thence it runs 2 cm. obliquely forward and inward through the bladder muscle and beneath the mucous membrane, and emerges at the angle of the trigone 3 cm. from its fellow and the same distance from the urethral orifice.

Topographical Anatomy.—The ureter, like the appendix, cannot be felt when normal. When tender or enlarged, however, in a thin subject it may be traced almost from the kidney to the brim of the pelvis. In fleshy subjects it can only be felt at this latter point—viz., at the outer edge of the rectus muscle on a line joining the anterior spines of the ilia. In the female pelvis the diseased ureter is felt through the vaginal vault almost up to the pelvic brim. But in the male it is only in exceptional cases that tenderness or enlargement at the lower extremity of the ureter can be appreciated by rectal touch in the region just internal to the base of the seminal vesicle.

PHYSIOLOGY

The ureter transmits the urine from the kidney to the bladder by its peristaltic action.

Waves of contraction run along it quite as along the intestine, and as each wave reaches the bladder the ureteral orifice becomes

slightly raised and tumefied, emits a little jet of urine, and then sinks back again. This is perhaps the most picturesque phenomenon observable through the cystoscope. The contractions of the two ureters are quite independent and not often synchronous. They recur irregularly every five, ten, or twenty seconds. Exceptionally the intervals are much longer.

Like the bladder, the ureter is insensitive to touch unless inflamed, except at its vesical orifice. But, like the bladder, it is extremely sensitive to distention—witness the agonizing pain of renal colic. Whether those obscure cases of renal colic attending the passage of concentrated crystalline urine are due to distention or to simple scratching of the ureteral walls it is impossible to say. Dr. Bryson has advanced the theory that pain of the upper third of the ureter is radiated to the kidney, pain of the middle third to the abdomen, and pain of the lower third to the bladder and urethra. While this is usually the case, vesical pain of renal origin may be due to a disturbance solely in the renal pelvis without any implication of the ureter.

EXAMINATION

The methods of examining the ureter are reducible to two: (1) Palpation (Chapter I); (2) urethral catheterization and its various modifications (Chapter V).

MALFORMATIONS

These are described on p. 536.

URETERITIS AND STRICTURE

Ureteritis, whether due to pyogenic bacteria alone or excited by stone or tuberculosis, is but a feature of the larger renal condition and is accordingly considered therewith.

Ureteral stricture is usually due to tuberculosis or stone, less often to chronic simple ureteritis, to trauma (operation) or to congenital malformation. The stricture results in hydro- or pyonephrosis. A pre-operative diagnosis may be made by pyelography. The treatment is by dilatation, resection or nephrectomy (cf. p. 701).

URETERAL NEOPLASMS

Cysts of the ureter are extremely rare. Mucous cysts may occur, and cystitis cystica may extend up the ureters.

Epithelial Growths.—The solid neoplasms of the ureter are epithelial formations, papilloma, carcinoma, and epithelioma.[1] These tumors have been studied by Albarran,[2] who has collected 65 cases. Their histogenesis is quite the same as that of vesical tumors. They usually begin as seemingly benign growths and become malignant secondarily, arising in the renal pelvis and being propagated downward by direct extension or by implantation. In the kidney they may produce secondary deposits or give rise to hydronephrosis, or pyonephrosis. The kidney, bladder, retroperitoneal glands, and the liver or the pleura, may be involved secondarily. The youngest patient was twenty-seven years old, the oldest eighty-nine. In 8 cases there was stone in the kidney.

Symptoms.—The symptoms are those of renal stone or tumor. Bleeding is usually noted (79 per cent) and is often the first symptom. Tumor was noted in 70 per cent of the cases, pain in 60 per cent. The diagnosis has been made only by the observation (through a cystoscope) of a villous tumor protruding from the ureteral orifice. The tumor has otherwise been either unrecognized or mistaken for a renal growth.

Treatment.—The treatment is wholly operative. Nephrectomy has been performed 21 times, with 3 deaths and 8 known recurrences. One case of papilloma was known to be well fourteen months, and 2 of carcinoma four and six years after operation.

Inasmuch as the recurrence almost invariably appears in the ureteral stump, the duct should be removed entire. Cystoscopy will determine whether a portion of the adjacent bladder wall should be resected with the tumor.

URETERAL FISTULAE

Ureteral fistulae have many causes. Congenital ureterorectal and ureterovaginal fistulae are extremely rare. Acquired fistulae, on the contrary, occur in any portion of the ureter: at the upper end after nephrectomy, especially if the ureter is actively tuberculous. In other parts of its course cutaneous fistulae form after the duct has been inadvertently divided during an abdominal operation or after rupture from stone, stricture, or other disease, such as tuberculosis and neoplasm, or from trauma or pressure of some intra-abdominal growth usually of the uterus or ovary, or from injuries inflicted during labor.

The essential cause of the persistence of fistula in all such cases is obstruction of the ureter, usually by stricture, between the fistula and the bladder. If this obstruction is relieved the fistula will heal.

[1] Morris has, however, collected 3 reported cases of sarcoma.

[2] "Les tumeurs du rein," Paris, 1903.

The discharge from the ureteral fistula is usually uropurulent, sometimes simply purulent, and rarely simply urinary. The presence of urine in the discharge may be taken as presumptive evidence that the fistulous ureter leads up to a functionating kidney. Yet the presence of urine does not prove a connection with the kidney, for the urine may regurgitate from the bladder through a ureteral fistula, if the ureter is gravely diseased.

Treatment.—The treatment of cutaneous fistula is nephrectomy if the kidney has ceased to functionate, dilatation by ureteral catheter or ureteral anastomosis if the kidney is worth saving (p. 701).

The treatment of ureterovaginal and uretero-uterine fistula is no simple matter. The great variety of operations employed for its cure, the great proportion of failures after most of these, and the total absence of concerted surgical opinion upon the subject, attest the complexity of the problem. Abdominal ureterocystoneostomy should be tried. Hysterocleisis and colpocleisis are operations of last resort. The functional result of including the uterus or the vagina in the urinary reservoir is anything but satisfactory. If all attempts at ureterovesical anastomosis fail and the opposite kidney is healthy, nephrectomy is preferable to colpocleisis.

CHAPTER XLVII

HYDRONEPHROSIS

Obstruction to the outflow of urine down the ureter is of two kinds: (1) Sudden complete obstruction, (2) gradual or incomplete obstruction.

Sudden complete obstruction occurs clinically under two forms, viz., by a calculus and by the surgeon's ligation. In either event the result is the same. The urine is dammed back upon the kidney, causing an acute renal congestion and a diminished secretion of urine; but even this increases the intrarenal pressure. The congestion is exchanged for atrophy after little dilatation has occurred, thus terminating the usefulness of the organ. The details of these changes are described under Calculous Anuria.

Gradual, incomplete, or intermittent urinary obstruction sets up a very different train of events. Some urine escapes past the obstruction, continuously or from time to time, and affords partial relief to the renal tension, while still keeping up a very considerable pressure. Thus the organ does not atrophy. It continues to excrete an amount of urine equivalent to what can pass the obstruction, while the continued high pressure within the kidney causes a gradual dilatation of its cavity. Pelvis and calices gradually dilate—and there is hydronephrosis (cystonephrosis, nephrectasis, renal distention, uronephrosis).

The above-described pathogenesis of renal atrophy and hydronephrosis has been experimentally worked out by Guyon,[1] Byron Robinson,[2] and others.

The influence of infection in causing hydronephrosis is not clear. All specimens of grave chronic renal infection exhibit some slight dilatation of the renal pelvis, even though there be no appreciable obstruction. On the other hand there is *a priori* reason to believe that grave chronic renal infection does not occur in the absence of all retention. Furthermore animal experiments have shown that infection is a predominating cause of hydronephrosis. Even the kidney whose ureter is closed by ligature becomes hydronephrotic if mildly infected, while "infection of the non-stenosed ureter causes hydronephrosis" (Beer [3]).

[1] *Guyon's Annales,* 1892, x, 161.

[2] *Annals of Surgery,* 1893, xviii, 402.

[3] *Am. J. Med. Sci.,* June, 1912.

ETIOLOGY

The cause of hydronephrosis is gradual, incomplete, or intermittent urinary obstruction. The obstruction may be either urethral or ureteral.

Urethral Obstruction.—The common urethral obstructions are stricture and prostatism. But the former always and the latter usually damages the kidneys more by infection than by dilatation. The bladder bears the brunt of the distention, and, although the kidneys and ureters become dilated by chronic urethral obstruction (Fig. 49), this dilatation is clinically subordinate to the inflammatory features of the disease.

Ureteral Obstruction.—Ureteral obstruction acts differently. No distensible bladder intervenes to distribute the pressure, and infection is often entirely absent; so that the aseptic dilatation of kidney and ureter progresses rapidly and unobscured:

The ureteral obstructions are:

1. Obstruction from within by stone, tumor, or foreign body (Fig. 80).

2. Pressure from without by aberrant renal vessel (Fig. 98) or by pelvic growth.

3. Kinking of the ureter from nephroptosis or misplaced kidney.

4. Strictures and valves of the ureter, especially those caused by anomalous origin of the duct or by stricture at its termination.

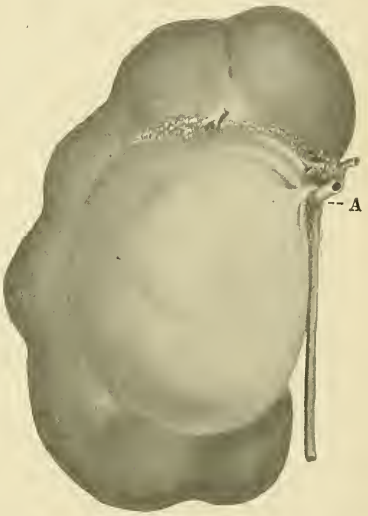


Fig. 98.—Hydronephrosis from Ureteral Compression (at A) by a Branch of the Renal Vein. This obstruction caused an intermittent hydronephrosis, which was permanently cured by the ligation of adhesions and nephropexy.

5. Congenital dilatation of the whole ureter with the kidney, either with or without stricture of the vesical orifice.

6. Trauma to the kidney causing true or pseudohydronephrosis.

7. Ureteral trauma, whether partial division of the duct, stripping it of its blood supply (as in the Wertheim operation), or ligature. Ligature with simple catgut leaves a permanent stricture.

Roberts[1] has examined 52 cases in reference to their etiology. Twenty were bilateral and 32 unilateral. The cause was congenital

[1] "Urinary and Renal Diseases." Second American Edition, Philadelphia, 1872, p. 482.

in 20 cases. In 2 of these a supernumerary renal artery crossed and compressed the ureter near its origin; in 4 the ureter was congenitally imperforate; in 4 the ureter entered obliquely into the pelvis of the kidney; in 1 the ureter was kinked and adherent; in 1 there was stricture at the vesical extremity. Thirteen of these congenital cases were bilateral. Of these, 2 were still-born, 5 died within six months (3 within forty-eight hours) after birth. Four lived from five and a half to twenty years. One [1] survived to the age of thirty-eight.

Of the 32 cases of acquired hydronephrosis, 11 were due to impacted ureteral calculi (3 others were attributed to the same cause); 5 showed inflammatory or ulcerative stricture; 9 were occluded by external pressure—by peritoneal adhesions (3 cases), gravid uterus, ovarian cyst, cancerous growth.

Morris has analyzed 142 cases, of which 128 were due to obstruction of the ureter, by cancer of the pelvic organs (118), cancer of the abdominal organs (3), ovarian cysts (4), and "constriction of the ureter" (3). Yet hydronephrosis due to cancerous obstruction is rarely noted except post mortem.

The so-called traumatic hydronephrosis is almost always an encysted perinephritic extravasation.

A special cause of hydronephrosis, a cause that figures but rarely in statistics and yet is commonly encountered in practice, is nephroptosis. Certainly renal mobility is associated with practically every case of intermittent hydronephrosis, and in a great majority of hydronephroses due to kinked and adherent ureters, whether over an aberrant renal vessel or not, and to oblique implantation of the ureter in the kidney pelvis, the first kinking of the ureter or pouching of the pelvis is attributable to a nephroptosis (Fig. 98).

PATHOLOGY

The morbid conditions at the point of ureteral obstruction require no detailed description. The strictures, adhesions, etc., present no peculiar features.

The Hydronephrotic Sac.—The tumor may consist of only a part of the kidney, whether because the kidney possesses two ureters, only one of which is blocked, or because a single calyx becomes occluded by a stone. Either condition is very rare; as a rule, the sac consists of the entire kidney and its pelvis. The ureter may also be dilated.

The size of the tumor varies from that of a normal kidney to that of a child's head.

The sac wall consists of the renal pelvis and capsule. The kidney

[1] Kinked and adherent ureters, doubtless not congenital.

caps the tumor. The outer surface of the mass is irregularly ovoidal, the inner surface is irregular. If the hydronephrosis is small its interior consists of the dilated pelvis and calices (Fig. 98). If large, it is a great, smooth-walled cavity crossed by fibrous septa representing the remains of the columns of Bertini (Fig. 39). The sac wall may be thin, but is usually tough and fibrous. Cartilaginous nodules have been observed in it.

Renal Changes.—The changes in the kidney substance are interesting. At first the kidney is congested, the canaliculi dilated, and the cells flattened. This process soon manifests itself macroscopically by the thinning out of the kidney tissue. Thus the kidney becomes more and more spread out on the surface of the sac with a great portion of its secreting substance atrophied.[1] But this is not the only change. The remaining parenchyma cells—for the kidney is never completely atrophied—undergo a compensatory hypertrophy. They grow to three or four times their normal size and their secretory capacity increases accordingly. It is for this reason that every hydronephrotic kidney should be recognized as a useful, though an impaired, organ, and should not be sacrificed unnecessarily.

The hydronephrotic sac may be open or closed. If the ureter is merely kinked, the hydronephrosis is usually intermittent. If contractured or obstructed, the hydronephrosis is fixed or constant, and the orifice of the sac may finally become absolutely sealed.

The Fluid.—The normal kidney pelvis will hold from two to eight c.c. A pelvis that will hold more than 10 c.c. is dilated. The quantity of fluid in a hydronephrotic sac may reach 5 or 6 gallons. One case is reported (Glass) containing 30 gallons.

The quality of the fluid varies. A large ancient fixed hydronephrosis usually contains a simple solution of sodium chlorid, though it may contain urea, albumin, urinary crystals, epithelial cells, and leukocytes, and less often blood or cholesterin.

There may be a catarrhal pyelonephritis, with slight infection of the contents of the sac (infected hydronephrosis). This light infection does not materially influence the clinical aspect of the case, but hastens the destruction of renal parenchyma.

Physiology.—The hydronephrotic kidney secretes a urine less rich in solids than that of a normal organ; but Guyon and Albarran [2] have shown that even the kidney whose ureter has been occluded for a great while will begin to secrete when the obstruction is removed. Urea appears in the secretion, though it may have been entirely absent from the fluid in the sac; while the quantity of fluid secreted by the diseased

[1] There is no interstitial sclerosis, no production of fibrous tissue, in simple uninflamed hydronephrosis.

[2] *Guyon's Annales,* 1897, xv, 1200.

organ is excessive as soon as the pressure of retention is relieved. In one case (infected) in which the renal tissue was so compressed that it was only 2 or 3 mm. thick, the kidney excreted a liter a day after the pressure had been removed.

The kidney whose outlet has not been entirely closed acts in a similar manner. While a normal quantity of urine may be excreted by the diseased organ, it is poorer in urea and salts. It usually contains one-quarter to one-third of the total urea. While the total excretion of urea may vary widely from day to day, this variation takes place almost entirely in the sound kidney, the diseased organ excreting an approximately constant amount.

SYMPTOMS

Many kidneys found hydronephrotic post mortem give no symptoms during life. The one characteristic symptom by which attention is called to the kidney is the presence of a tumor. There are clinically two varieties of hydronephrosis. When the tumor is constant the hydronephrosis is spoken of as fixed; when the tumor varies in size the hydronephrosis is said to be intermittent.

Fixed Hydronephrosis.—When the hydronephrosis is fixed the patient usually gives a history of a slowly growing *tumor* in his side. Or soreness and *pain* may first call attention to the kidney; but, as a rule, unless the kidney is misplaced and adherent, fixed hydronephrosis is uncomfortable rather than painful. The tumor grows very slowly. It may burst either into the peritoneal cavity or into the perirenal space; either event is rare (cf. Babitski[1]).

On examination a smooth, elastic, fairly movable, and, as a rule, insensitive tumor is found filling the side. The absence of systemic disturbance is remarkable. There is no fever, and, unless both kidneys are affected, no evidence of renal insufficiency.

Intermittent Hydronephrosis.—This condition presents an entirely different picture. The trouble begins with irregular attacks of severe pain in the side. These pains are habitually attributed to the intestines, to hysteria, or to renal colic. When the patient is examined between attacks the discovery of a movable and tender kidney confirms the diagnosis of hysteria, and if the patient becomes thin and anemic and has flushes of watery urine, this only adds color to the picture.

But affairs go from bad to worse. The attacks of pain become more and more severe, they recur every few days. During the attack the distended kidney may be felt filling the entire loin. The pain, after lasting several hours or days, is suddenly relieved by the passage of a large quantity of urine; but the relief is only temporary. At the end

[1] *Archiv f. klin. Chir.*, 1912, xcvii, No. 4.

of the usual interval the pain recurs. In a personal case the pains began twenty years before the tumor was found, while in another the tumor reached enormous dimensions after less than ten years' growth.

Hematuria is an unusual but striking feature of some cases. The hemorrhage may be repeated and profuse.

Morris justly remarks that not all these cases are due to renal mobility, and cites instances attributed to stone and to vesical papilloma. Yet Terrier and Baudouin, who collected 83 reported cases, showed that the condition was almost always associated with nephroptosis.

The usual outcome of an intermittent hydronephrosis is that it becomes fixed. The variations in size decrease and the pain becomes more constant and less severe.

DIAGNOSIS

It is scarcely possible to mistake a fully developed intermittent hydronephrosis. The large recurrent lumbar tumor is characteristic.

A fixed hydronephrosis may be distinguished as a chronic noninflammatory renal tumor. When large the cystic nature of the growth is obvious. It may then be mistaken for ovarian cyst. When small, it is not always possible to distinguish a hydronephrosis from other tumors of the kidney. The occurrence of hematuria may confuse the clinical picture.

Accurate diagnosis is made by the ureter catheter.

The urine obtained from the hydronephrotic kidney always shows some deficiency of urea and, unless the kidney is almost wholly destroyed, an increase in quantity as compared with its fellow (unless the condition is bilateral). The phenolsulphonephthalein output is much more markedly interfered with than that of urea.

If the ureter catheter can elude the ureteral obstruction and enter the kidney pelvis, the presence of hydronephrosis is immediately attested by a free flow of urine. This flow does not measure the capacity of the kidney pelvis for this cavity may not be distended at the time of catheterization. But however empty it may be there is always some residual urine present. To measure the capacity of the renal pelvis by filling it with fluid introduced through the ureter catheter is a dangerous experiment and has after all no value, for there is no advantage in knowing the precise size of the hydronephrosis. Moreover a much more accurate picture is obtained by pyelography.

Since ureteral peristalsis is lost above the ureteral obstruction, the situation of this may be estimated from the point at which the urine flows in a constant stream as though the end of the catheter were in the kidney pelvis.

If the catheter will not pass the ureteral obstruction, even if no urine is obtained, pyelography is again our salvation.

Thus pyelography is the last resort for an accurate diagnosis. It should only be performed with the patient in the hospital, ready to be operated upon if occlusion of the ureter results. Through it we may obtain, not only a precise picture of the dilatation of the kidney pelvis and of its ureter, but also considerable information as to whether the ureteral obstruction is due to a kinking of that canal or an actual stricture.

It is not to be forgotten that many of the smaller renal dilatations are actually not harmful to the patient so long as they drain freely into the ureter. A sharp angulation at the junction of ureter and kidney pelvis and a convexity of the lower border of the kidney pelvis (the so-called "derby hat" pelvis) suggests that drainage is not perfect. It is further to be noted that the normal ureter (with the patient on his back) drops in practically a straight line from the kidney pelvis to the brim of the bony pelvis.

The practice of taking pyelograms with the patient erect so as to bring out the kinking and convolution of the ureter has led to many mistakes in diagnosis, for the kinks and convolutions thus produced are not always pathological. Deductions should therefore be drawn only from pictures taken with the patient lying on his back.

PROGNOSIS

Unless both kidneys are affected hydronephrosis does not threaten life. The development of the tumor is very slow, and treatment is usually demanded for the relief of pain. Infection may occur, transforming the hydronephrosis into an infected hydronephrosis (common), or into a pyonephrosis (rare). Rupture of the sac is most exceptional. Morris noted the spontaneous and permanent disappearance of 6 or 7 out of 47 hydronephroses observed by him.

TREATMENT

Slight dilatations of the renal pelvis, up to a content of approximately 20 or 30 c.c., require no treatment unless they are sufficiently infected to cause toxemia or unless there is kidney pain. If these symptoms are absent such dilatations, accidentally discovered during ureter catheterization, may be noted but certainly require no treatment.

On the other hand, retention of small amounts of urine in the renal pelvis, like similar retention in the bladder, may cause symptoms of

PLATE XVII

Pyelogram of Hydronephrosis.

In the lower part of the opposite loin is seen the shadow of a lead-coated ureter catheter.

considerable severity. Under these circumstances, it will be found that the ureter does not drain the pelvis well. Such hydronephroses are usually intermittent. The treatment of such cases should be determined after the nature of the obstruction has been studied by pyelography. If the ureteral obstruction is a kink it can only be relieved by operation; if it is a stricture, it may be relieved, temporarily at least, by the indwelling catheter or by dilatation with ureter catheters of different sizes. Ureter stricture, like urethral stricture, may often be readily dilated and will sometimes remain dilated for years. But the patient should be warned of the possibility of relapse.

Hydronephrosis due to urethral obstruction can usually be relieved by the cure of this obstruction, though in some cases a secondary ureteral obstruction will have to be dealt with surgically.

Hydronephroses of larger content, due to ureteral obstruction, always cause symptoms and call for operative relief. This relief may be of two kinds: by removal of the obstruction, or by nephrectomy. Such cases may be grouped into three classes.

When both kidneys are affected, and pyelography shows a type of retention that cannot be relieved by ureter catheter or plastic operation, the bilateral impairment of renal function may be such as to forbid the removal of either kidney. Under these circumstances, the only operation to be contemplated is bilateral nephrostomy. It may be often deemed wiser to do nothing.

In a second class of cases, the hydronephrosis is unilateral, the function of the kidney reduced almost to zero, its parenchyma almost totally destroyed, and its pelvis pouched in a complex manner. Under these circumstances, one may well conclude that no plastic operation will really relieve the renal retention, and that the kidney is scarcely worth saving. Nephrectomy is the operation of choice.

In a third class of cases, the kidney is by no means totally destroyed, and the ureteral obstruction may be more or less readily relieved. If the latter is due to nephroptosis, to stone, to contraction of the ureterovesical meatus, to kinking of the ureter by adhesions or over an abnormal vessel, the indication for a plastic operation is obvious. Such obstructions may be readily relieved with a large chance of success. But the prospect of successfully relieving the obstruction may be interfered with in several ways. Most important of these is the condition of the opposite kidney. If this is such that nephrectomy would seem inadvisable or unjustifiable the operative indication must be very precise and the operator very sure of his success before any surgery is attempted; for the failure of a plastic operation under such conditions, by condemning the patient to nephrectomy, would perhaps condemn him to death.

But if the condition of the opposite kidney is good, almost any

plastic operation may be attempted with the assurance that if this fails, and nephrectomy is called for, this at least will not prove fatal.

The various plastic operations that may be required for the relief of hydronephrosis are described in another place. The plastic removal of spurs in the renal pelvis, caused by the so-called "high implantation of the ureter in the kidney pelvis" is not always easy of performance, and the resulting scar sometimes leaves the retention as bad as ever. An indwelling catheter should always be left in place at the close of such an operation. Transplantation of the ureter into the bladder is an even less satisfactory procedure. In spite of the most careful technic the drainage is likely to be imperfect, the ureter often becomes infected, and in fully half the cases the kidney, after going through a period of acute infection, at least becomes useless as an excretory organ, or at worst suppurates so acutely as to require nephrectomy.

On the other hand, the relief of hydronephrosis due to stone in the ureter, or to adhesions and kinking about the ureteropelvic junction, is one of the most satisfactory operations in renal surgery, while the relief of congenital stricture at the lower end of the ureter by cystoscopic incision of the ureter mouth is readily achieved.

Eliot[1] has collected the reports of 77 plastic operations upon the upper end of the ureter for the relief of hydronephrosis; 27 of them failed, 50 resulted in immediate successes; but only 11 of these were verified by subsequent examinations. In only 3 cases was the condition of the kidney verified more than a year after operation; two of these showed a normal function at 2 and 5 years respectively, a third showed a somewhat diminished function 7 years after operation.

[1] *Jour. d'Urol.*, 1913, iii, 161.

CHAPTER XLVIII

PHYSIOLOGY AND VARIOUS DISEASES OF THE BLADDER

PHYSIOLOGY

Capacity.—The capacity of the bladder is physiological, not anatomical (Guyon). Although in actual size the healthy bladders of different individuals do not differ materially, the actual capacity of the organ depends upon its sensitiveness, and this sensitiveness varies at different times and with different individuals. The physiological capacity of the bladder—the amount of urine which an ordinary bladder holds when the desire to urinate is first felt—is about 250 c.c. (8 ounces).

Sensitiveness.—The healthy bladder is quite insensitive to touch, except about the orifices of the ureters and the urethra, but very sensitive to tension. Thus a sound may be poked about in the bladder and cause no sensation whatever except in the prostatic urethra. On the other hand, the torture of "holding water" requires no comment. The sensitiveness of the bladder may be diminished by habit; beer-guzzlers and diabetics may not urinate more often than those who pass perhaps only half as much urine. The sensitiveness is, on the other hand, increased by nervousness and by inflammation.

Absorption.—Although the point is disputed, it is probable that the mucous membrane of the healthy bladder is practically as impervious as the skin. But fluids are rapidly absorbed through the mucous membrane of the posterior urethra, and also through the bladder epithelium when inflamed.

Contraction: Urination.—"Man urinates with his bladder, not with his urethra," says Guyon.

The mechanism of urination has been illuminated by fluoroscopy with this organ distended by some visible fluid. The posterior urethra remains empty as the bladder distends. The desire to urinate is associated with a contraction of the bladder which, if the impulse is resisted, passes over and returns with increased intensity. No urine flows into the posterior urethra until urination actually begins.

Curiously enough suprapubic prostatectomy, by destroying the internal sphincter, leaves the posterior urethra a funnel-shaped cavity.

As the bladder fills the posterior urethra fills with it. After prostatectomy, therefore, the urine is retained solely by the external sphincter.[1]

INCONTINENCE OF URINE

Incontinence of urine, or enuresis, is that condition in which the urine flows involuntarily out of the bladder as soon as it flows in. Incontinence must be distinguished from overflow. In each there may be a continual involuntary dribbling; but in the one case the bladder is empty, in the other it is full. Enuresis shows that the vessel leaks; overflow shows that the outflow pipe is obstructed. In the adult male dribbling of urine almost always signifies overflow. If there is true incontinence the urine flows away without any pain or desire to urinate. Imperative urination, when the inflamed bladder contracts every few minutes with a force that the cut-off muscle cannot oppose, is spoken of as false incontinence.

Incontinence may be partial or complete, diurnal or nocturnal.

Incontinence in Adult Males.—Stagnation with overflow and false incontinence have been already considered. True incontinence depends upon:

1. Postoperative enuresis, from overcutting the vesical sphincters.
2. Paralysis of the bladder.
3. Tuberculosis of the neck of the bladder.
4. Persistence of infantile incontinence.

Incontinence in Adult Females.—Women have weaker bladder sphincters than men, and among them such lesser irritations as uterine displacements, the pressure of tumors, and even trigonitis, may excite a most persistent and annoying incontinence of urine.

ENURESIS OF CHILDHOOD

Infants have little or no control over their urination, especially at night, but after they leave off diapers they are expected to stop wetting the bed. There are doubtless few children who fulfill this expectation entirely. Up to the age of five or six an occasional accident may occur to the most normal child. But this is not enuresis. The true nocturnal enuresis of children—for it is only exceptionally diurnal—is not noticed, as a rule, until the child is five or six years old. Then he begins to wet his bed quite regularly, perhaps two or three times every night. He may also lose his urine involuntarily by day, and very rarely the incontinence occurs only by day and not by night.

[1] Cf. Cecil. *Journ. A. M. A.*, 1915, lxv, 1436.

Etiology.—The cause of enuresis is sometimes obvious enough, but usually obscure.

1. Enuresis due to congenital deformity such as epispadias is readily diagnosed.

2. Enuresis due to tuberculosis or stone is overlooked with singular frequency. The little patient cries out when he urinates and complains of various pains, but the physician often fails to consider the symptoms and neglects to examine the urine. Needless to say a careful urinary examination for pus and other elements should precede the treatment of any case.

3. Many cases are associated with phimosis, pin worms, adenoids, hypertrophied tonsils, and other of the minor diseases of childhood. The enuresis may often be relieved by their removal and is therefore usually spoken of as reflex. Without quarreling about the treatment, one may question the theory. These little lads are often thin and anemic and their enuresis is apparently due to this general condition rather than actually reflex.

4. In general it may be said that a child with enuresis who is below par should be a subject for hygiene in the hope that the improvement of his general condition may relieve the bed wetting.

5. Enuresis is rarely associated with such nervous disorders as chorea, tabes, etc.

6. There remains a large, perhaps *the* large, class of patients still unaccounted for. Their adenoids have been removed, they are not anemic, deformed or tuberculous, their urine contains no pus, and their nervous system is intact. The cause of enuresis in these cases is unknown.

The three latest theories to account for it are: (1) Insufficient nervous impulse, (2) thyroid insufficiency, (3) mild tuberculosis.

Prognosis.—Even though all treatments fail, the prognosis is excellent. With the advent of puberty the child is almost certain to stop bed wetting.

Treatment.—As has been stated above, the treatment of the enuresis should be preceded by a careful examination of the patient for enlarged adenoids or tonsils, for pin worms, for adhesions of foreskin or clitoris, the urine should be collected and examined for albumin and sugar, and for pus and bacteria. If pus is found, stone or tuberculosis may be suspected. The blood should be examined for anemia, and the child carefully gone over for evidences of tabes or chorea.

In most instances, the examination will fail to reveal any of these conditions, and we are left with the so-called idiopathic enuresis. Many devices have been suggested and successfully employed for the treatment of these cases; such as the cutting down of the amount of water drunk, especially after three o'clock in the afternoon, getting the child

into good habits by wakening it at night to urinate, and actually interfering with urination by some form of urethral compressor placed on the penis at night. (If such machinery is to be used, the parents should be carefully instructed so that no harm shall be done to the child.)

If these remedies fail, we may have recourse (with little hope of success, I confess) to drugs empirically employed. Extract of belladonna, beginning with a dose of gr. 1/10, and increasing until the pupils or the throat show the physiological effect, is well spoken of. Perlis states he cured 102 out of 156 cases by administering rhus aromatica; he employs the fluid extract in doses of from 10 to 80 minims. I have used both of these remedies without success. One may turn with more confidence to treatment founded upon a definite theory. Thus if we believe in the lack of nervous impulse, this may be stimulated by Cathelin's suggested injection of 20 c.c. of normal salt solution into the sacral canal. This I have tried several times without success. Or we may try faradization of the membranous urethra by means of a urethral electrode or stimulation of the nerve endings by instillations of a few drops of strong silver nitrate solution into the posterior urethra. These treatments I have also employed in vain.

Hertoghe and Williams[1] claim excellent results from the use of thyroid extract in small doses. To children between 2 and 6 years of age, ½ gr. of dried thyroid extract may be given twice a day; for the older children the dose may be gradually increased to four or five times as much.

Keersmacher claims excellent results from treating enuresis on the theory that it is a manifestation of slight general or pulmonary tuberculosis. He states that his patients usually show a slight evening rise of temperature, and positive von Pirquet test. He administers tuberculin in the usual manner, and states that his results are excellent.

POSTPROSTATECTOMY ENURESIS

Incontinence of urine may follow any operation upon the prostate or bladder neck. It is so much more often seen as a result of perineal prostatectomy than after any other operation that it seems not invidious so to label it. Its cause is most obscure, witness the following facts:

1. It does not follow perineal section for stricture, even though the membranous urethra is divided from end to end.

2. It does not follow suprapubic prostatectomy,[2] even though the

[1] *Lancet*, May 1, 1909, p. 1245.

[2] Though it must be admitted that partial incontinence may rarely follow suprapubic prostatectomy.

internal sphincter is freely divided and the whole prostatic urethra torn away.

3. It does follow Bottini's operation, which divides only the internal sphincter.

4. It is seen after Chetwood's operation and perineal prostatectomy.

5. It occurs almost as often after simple operations as after complex and destructive ones.

Doubtless, therefore, the physical basis of incontinence is operative disturbance of any part of the sphincteric mechanism. Some are incontinent by day, others by night.

Treatment.—Incontinence during the first weeks after operation is unimportant. The patient should be reassured and a complete cure hoped for. But if the incontinence persists much good may be done by filling the bladder with an unirritating solution and then training the patient by bidding him "start—stop—start—stop" until the bladder is empty.

Instillations of silver nitrate are distinctly useful until the urethroscope shows the posterior urethra to be entirely healed.

If, at the end of six months, the patient is still incontinent the membranous urethra should be sutured. I have thrice performed this operation with two failures and one success.

PARALYSIS OF THE BLADDER

True paralysis of the bladder is one of the gravest complications of fracture of the spine and other injuries and diseases to the lower spinal cord. Under such circumstances, the cause of the condition is obvious enough, and its treatment futile unless the spinal lesion can be cured.

Of singular interest, however, is that paralysis of the bladder which results from tabes. This is not infrequently one of the earliest lesions of tabes. It occurs usually at a period of life but little antecedent to that when prostatism is common. Consequently it is often mistaken for prostatism by the most accurate observers. I have recently seen several cases with paralysis of the bladder due to tabes who gave no history of syphilis, and no evidence of the disease excepting the paralyzed bladder, absence of deep muscular sensibility, and absence of ankle jerk. All of the other reflexes were entirely normal, the blood was negative to Wassermann reaction; but the spinal fluid showed the characteristic lymphocytosis and positive Wassermann reaction.

The symptoms of this condition are comparable to those of prostatism; inasmuch as retention of urine is one of the striking features. In the clinical history, however, it will often be noted that the lack of deep muscular sensation while permitting these patients to go around

with greatly distended bladders and little discomfort also permits them to urinate with great infrequency. Indeed, one occasionally learns that the patient cannot urinate at all until the bladder fills to almost overflowing; then, by an effort, urination can be started, and the bladder entirely emptied. The condition may be suspected when rectal examination and cystoscopy fail to show a prostatic enlargement adequate to explain the retention of urine. It may also be suspected when there is a striking variation in the amounts of retained urine, when the frequency of urination does not compare with the amount of retained urine, when there is a history of syphilis, and of lack of sexual power, when the trabeculation of the bladder is out of all proportion to the prostatic enlargement.

It has been frequently stated that a certain type of trabeculation, most clearly marked about the ureter orifices, is characteristic of tabes. This is by no means the case.

The diagnosis is made by an examination of the reflexes, notably the ankle jerk, and of the spinal fluid, and by cystoscopy.

Prostatism and paralysis may, of course, co-exist.

Infection occurs early and dilatation and infection of the kidneys follow just as they do in prostatism. But the management of these cases by the catheter is much more successful than it is when the prostate is enlarged.

The prognosis of tabes itself is intimately bound up with the prognosis of these bladder and renal infections. Barney[1] states that 50 per cent of all tabetics die of renal infection and insufficiency.

Treatment.—The essential treatment is that of the tabes. If the bladder paralysis is not of long duration, one may hope that a vigorous antisyphilitic treatment will control the tabes, and relieve the paralysis of the bladder muscle at least to the extent of permitting the bladder to empty itself.

While awaiting this cure, the patient should be regularly catheterized, often enough to keep the bladder from becoming overdistended, and should receive appropriate treatment by bladder irrigation and hexamethylenamin.

By close attention to the detail of systematic catheterization, and the employment of such combinations of hexamethylenamin and irrigation of the bladder as best suited each individual case, I have, in a number of instances, succeeded in keeping the bladder practically clean and in protecting the kidney from any important dilatation or infection for as much as ten or twenty years.

One can scarcely hope to cure retention of urine due to paralysis of the bladder by operation. Yet if there is a considerable prostatic enlargement it may be worth while to remove this, both in order to make

[1] *Boston Med. & Surg. Jour.*, 1910, clxiii, 933, 995; and 1911, clxiv, 13.

catheterization safer, and in the hope that the retention may actually be relieved. In such instances, however, one must not forget the possibility of exchanging an unpleasant retention for an unbearable incontinence. "Better be a catheter man than a bag man," as a wise old gentleman once said to me.

The reported operative cures may be taken with a grain of salt. I have reported some myself. But if stricture or prostate call for operation, an intelligent opening up of the bladder neck may really have excellent results in relieving some of the patient's symptoms, even to the point of emptying his bladder.

HERNIA OF THE BLADDER (CYSTOCELE)

Cystocele is scarcely recognizable except during herniotomy, and its whole clinical interest centers on the diagnosis of the condition before the bladder is injured by the knife, and on its remedies in case it is so injured.

Abdominal, inguinal (scrotal, sometimes on both sides), crural, perineal, and ischiatic cystocele, and cystocele through the foramen ovale have been noted. In women vaginal cystocele and femoral cystocele are most common; in men, inguinal. Thus, among 22 femoral cystoceles collected by Gibson,[1] 16 occurred in women, while 70 among his 77 cases of inguinal cystocele occurred in men. Lotheissen [2] collected 113 cases of inguinal cystocele in men and only 11 in women. He believes that cystocele occurs in 3 per cent of all inguinal herniae, although the usual estimate is from 1 to 2 per cent. Inguinal cystocele is extraperitoneal in 69.2 per cent of cases, paraperitoneal ("mixed") in 24.2 per cent, and intraperitoneal in only 6.6 per cent. As extraperitoneal cystocele is met with only in direct inguinal herniae, it is in this class of cases that cystocele is to be looked for.

Cystocele is especially common between the ages of thirty and sixty. Its pathogenesis, depending partly upon the hernial traction, partly upon dilatation of the bladder, has been studied by Lotheissen, Lambret,[3] Cheesman,[4] and Alessandri.[5]

Diagnosis.—The diagnosis is rarely made before operation. The suspected presence of cystocele is verified by the introduction of a sound into the bladder.

Treatment.—The proper treatment of cystocele is herniotomy. If

[1] *Med. Record*, 1897, li, 401.
[2] *Brüns Beiträge*, 1898, xx, 727.
[3] *Bull. méd.*, 1899, xiii, i, 397.
[4] *Med. Record*, 1901, lix, 985.
[5] *Guyon's Annales*, 1901, xix, 25, 153, and 325.

the cystocele is extraperitoneal, it may not be easy to close the abdominal wall firmly over it. Unintentional incision of the bladder during herniotomy is rather a grave complication. Lotheissen collected 65 such cases with 18 deaths. The bladder should be closed by two layers of Lembert sutures, the efficacy of the line of suture tested by the intravesical injection, and the radical cure completed. At the end of the operation a catheter should be tied into the urethra. If the patient's condition does not warrant the delay necessary to accomplish a satisfactory suture of the bladder, the organ may be fixed in the external wound and permitted to heal after the manner of a suprapubic cystotomy wound.

INTESTINAL FISTULA

Vesico-intestinal fistula may be traumatic, ulcerative, cancerous, tuberculous, or congenital. Congenital fistula is extremely rare. Ninety-five reported cases of acquired vesico-intestinal fistula in man have been collected by Chavannaz.[1] Of these, 13 were traumatic, 29 ulcerative (from stone, abscess, etc.), 19 cancerous, 7 tuberculous, and 27 unclassified. The fistula usually opens into the rectum (43 cases) or into the sigmoid flexure (14 cases), but it may open into almost any part of the intestine, even the appendix vermiformis (as a result of the bursting of an appendicular abscess). The fistula may be short and direct, but in fully 25 per cent of the cases there is an intermediate suppurating cavity between the vesical and the intestinal orifice.

Symptoms.—The most notable symptom of vesico-intestinal fistula is the passage of gas from the urethra (*pneumaturia*). This symptom is always present and is always noted by the patient. The urine may also be passed partly or wholly by the bowel, and, when the opening is large, feces may enter the bladder and issue with the urine. Cystitis is inevitable.

Diagnosis.—As a rule, the diagnosis may be made from the presence of pneumaturia, although gas may be evolved by fermentation within the bladder itself. Thus the intravesical action of the yeast fungus upon saccharine urine has been known to cause pneumaturia, and I have seen two obscure cases in which the presence of gas could not be accounted for. If the evidences of bladder disease do not sufficiently confirm the diagnosis of fistula, an injection of methylene-blue solution into the bladder will decide the question by transuding through the fistula and appearing in the dejecta. The position of the fistula may be estimated by cystoscopy, by rectal touch, or by the rectal speculum.

[1] Cf. Parham and Hume (*Ann. Surg.*, 1909, 1, 251), who have collected 385 cases; also Minakuchi (*Beitr. z. Geburts. u. Gynec.*, 1913, xvii, No. 3), who enumerates 45 cases, 27 of them due to obstetrical and operative injury.

Prognosis.—The prognosis depends on the nature of the fistula. Traumatic fistulae often heal spontaneously if the bladder is kept clean and the urethra clear. Tuberculous and malignant fistulae will not heal.

Treatment.—Palliative treatment consists of daily irrigation of bladder and bowel. Colostomy is the only appropriate treatment for incurable fistula. Temporary colostomy is also employed as a preliminary to the attempt at radical cure.

A radical cure may be attempted in several ways. Chavannaz reports three cures by dilating the fistula and scraping its rectal extremity. Separation of the viscera through a laparotomy, and excision of the fistula with suture of its orifice is the proper radical operation.

CHAPTER XLIX

DISEASES PECULIAR TO THE FEMALE BLADDER

Many of the conditions peculiar to the female bladder require no special mention here, or are sufficiently dealt with elsewhere in this work. Thus, for example, the bladder very rarely becomes tuberculous as a result of invasion from the fallopian tube. Acute infection of the uterine adnexa may involve and rupture into the bladder. Adhesions may cause irritation and even cystitis by pulling upon the bladder, and the fibroid uterus may cause similar results. The pregnant woman often suffers a temporary bladder irritation and cystitis. The so-called puerperal pyelitis is a usually descending infection.

But certain features of the pathology of the female bladder require a rather more detailed mention.

CYSTOSCOPIC PECULIARITIES OF THE FEMALE BLADDER

Although cystocele may occur in the virgin, as a general rule the bladder of the woman who has not borne children presents a cystoscopic picture not very different from that of the young male. If anything, the trigonal landmarks are not so clearly and distinctly marked, so that the ureters are harder to find.

But the multipara usually loses practically all the trigonal markings. The ureters are found only by a knowledge of where they should be looked for. There is no interureteric ridge or lateral edge of the trigone sufficiently marked to lead the eye to them.

This absence of trigonal markings is most commonly seen in cases of cystocele. The amount of cystocele may be measured, not only by the bulging to be seen in the vagina, but also by the amount of residual urine, as well as by the angle to which the cystoscope must be brought in order to approximate its lens to the ureteral orifices. These will usually be found much nearer the urethra than the inexpert cystoscopist expects to find them.

Marked cystocele causes retention of urine and symptoms in the female similar to mild prostatism in the male.

Marked anteflexion of the uterus and tumors on the anterior uterine wall as well as other pelvic tumors and adhesions may depress and

distort certain portions of the bladder wall (Pl. I). Pregnancy has a similar effect.

Carcinoma of the Cervix.—When a carcinoma of the cervix uteri invades the anterior or lateral vaginal walls, the most accurate means of ascertaining the condition of the vesicovaginal septum is by means of the cystoscopic examination. The cystoscopic examination becomes progressively more important as the growth extends, and the nearer it approaches the borderland between operative and nonoperative.

When the carcinoma approaches and invades the vesicovaginal septum it interferes with the blood supply of the bladder, particularly in those portions supplied by the middle and inferior vesical vessels. And cystoscopically we have bladder pictures of all grades of venous stasis (Pl. I).

A number of these bladder alterations are similar to those occurring with vesical or perivesical inflammations, and care must be taken in distinguishing between the two. The differentiation can, however, practically always be made.

The cystoscopic examination includes:

A. Estimation of the direction of the urethra and the position of the trigone, marked elevation of the trigone meaning inoperable carcinoma.

B. Conditions within the bladder:

1. Tumor masses encroaching upon or causing retraction of the bladder.
2. The alterations of the bladder which are similar to those occurring with vesical or paravesical inflammations. These are (*a*) folding and swelling of the bladder mucous membrane, (*b*) varicosities of the bladder vessels, (*c*) submucous hemorrhages, (*d*) congestion of the bladder, (*e*) cystitis, (*f*) bullous edema. The most important among these conditions within the bladder which indicate involvement of the vesicovaginal septum are: Tumor masses encroaching upon or causing retraction of the bladder; folding and swelling of the bladder mucous membrane; marked varicosities.

Bladder Neuroses.—Bladder neuroses can be divided into three classes: *First,* those due to a definite nerve lesion, e. g., tabes dorsalis. *Second,* those in which the nerve lesion is not definitely known—as when we have bladder disturbances in a neurasthenic or hysterical patient. *Third,* those in which the bladder disturbance is a reflex, as in a rectal fissure or disease of the pelvic organs.

These conditions are seen alike in men and women. The general symptomatology of bladder neuroses is classified by von Frankl-Hochwart as follows:

1. The Sensory anomalies.
   A. Pain.
   B. Anomalies of urination.
      a. Increase.
      b. Decrease.
2. Dysuria.
3. Urinary Retention.
4. Incontinence.

Pain.—The cause of painful and frequent urination is more often obscure in women than in men. Nevertheless, it always has a cause, and this cause should be disclosed by a careful examination. The physical examination should include an investigation both of the kidneys and of the pelvic organs for palpable displacement, adhesions, tumors, enlargement, inflammation, etc., which may, either by infection or by mechanical means, cause irritation of the bladder. If no such causes of the disturbance are found, one has recourse to cystoscopy, urethroscopy, and urinalysis. Thus we may, in a good many cases, readily rule out the usual stone, tumor, inflammation, tuberculosis, etc., which are common to male and female and give gross and readily recognizable lesions in most cases. There still remain cases of bladder pain and frequent urination to be accounted for. Many of these will be found to have a very slight infection dependent upon a mild pyelonephritis and curable by lavage of the kidney pelvis with silver nitrate or by improving the patient's general health. Others will be found to have mild degrees of cystocele and other slight displacements improvable by mechanical or operative means. Others still have obscure inflammations of the bladder which are of two types:

1. Ulcerative cystitis, which may be the simple ulcer of the vault described by Hunner or the diffused aphthous staphylococcus cystitis with little intervening general inflammation, or leukoplakia, or cystitis cystica.

2. Trigonitis, due to the extension of urethritis to the adjacent portion of the bladder base, is a diagnosis upon which the unskilled cystoscopist relies too often to explain a condition for which he can find no other cause. The diagnosis of trigonitis should only be made when the trigone is actually seen to be inflamed. The trigonitis may descend from the kidneys, or ascend from the urethra. If the kidneys are uninfected (as disclosed by culture of the urine) the trigonitis may be looked upon as of urethral origin, and a cure may be expected by treatment of the urethra, either by dilatation by sounds or by the application of 1 per cent silver nitrate solution, or 2 per cent carbolic acid, or 20 per cent argyrol.

Retention and Incontinence of Urine.—Retention is only interesting because it is so rarely looked for and hence so frequently

overlooked. Its results are quite the same in women as in men. It can usually be cured by dilating the urethra or by plastic operation for the relief of cystocele.

Incontinence of urine is a much more difficult topic in women, because the normal woman has so slight a hold upon her bladder sphincter. Many women not obviously diseased lose control of their bladder sphincter to a certain extent through such slight causes as catching cold or diarrhea. Incontinence is, of course, often a symptom of overflow in women as it is in men, and retention should always be carefully excluded in these cases.

Finally, there is a class of operative cases in which the sphincteric relaxation is due to pregnancy or to surgical operations. Kelly [1] has reviewed the treatment of this condition and advises for its operative relief a median vertical incision made in the anterior vaginal wall over a Pezzer catheter in the bladder to identify the position of the bladder neck. The vaginal wall is carefully dissected free until the finger can grasp at least one-half or two-thirds of the neck of the bladder including the contiguous urethra. Two or three lateral mattress sutures of fine silk or linen are then used to approximate the tissues on each side of the vesical neck. The first one takes in about 1.5 cm. of tissue, the next takes in another fold over this one. The catheter is removed, the superfluous vaginal mucosa resected, and the incision sutured in several layers with fine catgut. A perineorrhaphy may be done at the same time. Postoperative catheterization is avoided as far as possible. Kelly reports 16 successful operations.

[1] *Surg., Gyn. & Obstet.*, April, 1914, xviii, 444.

CHAPTER L

IDIOPATHIC RENAL HEMATURIA—VARICOSE VEINS OF THE BLADDER

IDIOPATHIC OR ESSENTIAL RENAL HEMATURIA

The hematuria that occurs with tumor of the kidney is at once the most important and the most profuse spontaneous hemorrhage from that organ. Bleeding is also a common symptom of renal stone and tuberculosis; and when the kidney bleeds, one of these three conditions—stone, tubercle, or tumor—is usually suspected. But there are a great many other diseases, a few of them surgical in their aspects and most of them medical, in which renal hemorrhage—even profuse renal hemorrhage—may occur. To such profuse hemorrhage from an obscure cause has been given the name of essential or idiopathic renal hematuria.

Etiology.—The causes to which this essential renal hematuria has been attributed may be classified as follows:

1. Hemophilia, scurvy, purpura.
2. Drug-poisoning (turpentine, cantharides, etc.).
3. Parasites (e. g., distoma hematobium).
4. Acute or chronic febrile diseases (scarlet fever, malaria).
5. Surgical diseases (hydronephrosis, renal mobility).
6. The passage of crystals.
7. Angioneurosis.
8. Chronic nephritis.
9. Papillitis.

It is not necessary to consider all these conditions in detail. Distoma, for instance, is practically never heard of in these latitudes. Renal hemorrhage caused by drugs or occurring in the course of one of the bleeding diseases has no surgical interest. There remain the hematuria due to surgical causes, to angioneurosis, to chronic nephritis, and to papillary varicosities. It is possible that any of these causes may produce a profuse renal hemorrhage. Ureter catheterization, pyelography and examination of the loin should eliminate hydronephrosis and movable kidney, and there are left for our consideration only angioneurosis, chronic nephritis, and papillary varicosity.

That hematuria may be due to chronic nephritis requires no proof. Examples are commonplace. But such examples, representing a hem-

orrhage—even a profuse hemorrhage or a series of such—in the course of an acute or active nephritis have no peculiar surgical interest.

What we need to know is whether a prolonged, profuse hemorrhage may result from chronic nephritis in the absence of any other sign of this inflammation.

Up to 1895, or thereabouts, the question was answered mainly in the negative. Otherwise inexplicable profuse or persistent hematuria was attributed to angioneurosis. But in the following decade many nephrectomies performed for this condition revealed, almost constantly, either parenchymatous or interstitial nephritis, which had given no symptoms or urinary signs other than the bleeding. In spite of the fact that the bleeding point was not found, the so-called idiopathic hematuria was therefore attributed to nephritis.

But as early as 1898 the bleeding point was found in three cases to be due to oozing from varicose veins of a renal papilla. Fenwick [1] reported six such cases, Hugh Cabot [2] added another, and subsequent observers have added others, preferring to attribute the condition to inflammation under the title "Papillitis." The affected papilla bleeds and looks purple and "spongy." Section demonstrates the varicosities.

Papillitis explains many but not all cases. A few still remain absolutely unexplained (cf. Schwyzer [3]).

Symptoms.—There is but one symptom—viz., profuse hematuria. This may be constant or intermittent. It is rarely sufficiently severe to cause anemia.

The bleeding may last a few hours or it may continue for days; having once occurred it may never appear again; or it may return time after time, and be so profuse as to threaten the patient's life. In the presence of a condition so various in its manifestations, so comparable in its only symptom to carcinoma of the kidney, so dangerous in its continuance, a diagnosis is of the utmost importance, and a diagnosis is difficult to obtain. Full realization of the fact that the bleeding, which is so often the first symptom of malignant growth in the kidney, may occur two, three, or even five years before any other symptom, cannot fail to impress upon the surgeon the necessity for the utmost caution in deciding the nature of the malady. It is not sufficient that the hemorrhage cease. This it does spontaneously. The patient should be warned that his bleeding may be the first symptom of serious renal disease and a careful examination insisted upon.

The surgeon must recognize that the more spontaneous the bleeding and the more entirely free the patient from any other symptom, the greater is the probability of malignant disease.

[1] "Clinical Cystoscopy," London, 1904.

[2] *Trans. Am. Assn. Gen.-Urin. Surgeons,* 1908, iii.

[3] *Ann. Surg.,* 1909, xlix, 628.

Diagnosis.—Renal tumor and idiopathic hematuria may usually be readily distinguished by palpation of a loin tumor and ureter catheterization, revealing a deficient function in the case of tumor. If these fail pyelography reveals deformity of the kidney by tumor. If the examination fails to show chronic nephritis, stone, tuberculosis or tumor, the diagnosis of papillitis or essential hematuria is made by exclusion.

Treatment.—Idiopathic renal hemorrhage may often be checked by the administration of 0.5 gram of turpentine in capsules three times a day. By this treatment I have been able to cure some five or six cases. In one striking case the patient had been bleeding profusely for a month. Every drop of urine passed was stained dark red by the contained blood. One week on turpentine sufficed to check the bleeding absolutely and permanently. Yet in another case the bleeding was checked by turpentine, recurred several years later, and was then not amenable to that drug, nor would the patient accept operative exploration.

Hagner [1] has checked several cases (notably one of constant bleeding for thirty-six years) by passing the ureter catheter. Others have achieved a like result by injection of adrenalin into the renal pelvis.

In case such methods fail, nephrotomy should be performed and the bleeding papilla curetted. If the papilla is not found, nephrotomy (or even decapsulation) may still cure. Nephrectomy is the last resource.

Braasch [2] reports 77 cases. In 26 cases ureter catheterization checked the bleeding (4 relapses); in 18 pelvic lavage succeeded (3 relapses); 6 were checked by adrenalin injection (5 relapses). Nephrotomy was performed 12 times with 7 cures. Nephrectomy was performed 16 times with one death.

VARICOSE VEINS OF THE BLADDER

A few cases have been reported which showed only one symptom—i. e., a spontaneous, profuse, uncontrollable hemorrhage of the bladder, which hemorrhage was found to arise from a ruptured varicose vein lying immediately under the mucous membrane. The diagnosis was made either by cystoscopy as the hemorrhage was ceasing, or by suprapubic cystotomy undertaken for the relief of the hemorrhage. If the hemorrhage does not stop spontaneously the only treatment is cystotomy with ligature or cauterization of the bleeding point.

I have several times seen varicose veins in the bladder (Pl. I), but have never known them to bleed.

[1] *Trans. Am. Urolog. Assn.*, 1907, i.

[2] *Jour. A. M. A.*, June 1, 1913.

CHAPTER LI

CYSTS AND TUMORS OF THE KIDNEY

CYSTS

Seven varieties of cysts occur in and about the kidney. These are:

1. Multiple small cysts.
2. Paranephritic cysts.
3. Large simple cysts.
4. Tuberculous cysts.
5. Cystic degeneration.
6. Echinococcus cysts.
7. Dermoid cysts.

1. Multiple Small Cysts.—Multiple small cysts are those dilatations of the renal tubules that are often seen in kidneys affected with chronic nephritis. They usually occur in the cortex and often project beneath the capsule. They may be single or multiple; they do not seem to attain a large size and are of purely pathological interest.

2. Paranephritic Cysts.—Paranephritic cysts also may be dismissed with a word. They are extremely rare; they may arise from the suprarenal capsule; they may be hydatid or the result of an encysted perinephritic hematoma. They are not distinguishable from other cysts of the kidney except by exploratory incision. Morris[1] has collected their published records.

3. Simple Cysts of the Kidney.—Single, large serous cysts are occasionally found projecting from the surface of the kidney. Such cysts may be single or multiple. They may be associated with chronic interstitial nephritis; they are rarely bilateral. The contents of the cysts are serous or hemorrhagic, never urinous. Such cysts give rise to no symptoms unless they attain such a size as to produce a tumor or to cause pressure pain. Under these circumstances the tumor is habitually mistaken for hydronephrosis, renal echinococcus, ovarian cyst, or some other tumor. Exploratory incision reveals the nature of the disease. The proper treatment of such cysts is to excise them with the adjacent portions of the renal tissue, or, if this is impracticable, to cut away as much of the cyst as possible, to scar the surface of the remainder with carbolic acid, and to close the lumbar wound, leaving

[1] "Surgery of the Kidneys."

a drainage-tube to the kidney. When the cysts are multiple Morris advises that the smaller ones be neglected. Engländer[1] has reviewed the reported cases from the surgical point of view.

4. Tuberculous Cysts.—Large cysts are infrequently seen in renal tuberculosis. They have no clinical interest.

5. Cystic Degeneration of the Kidney (*Large Polycystic Kidney*).—The kidney is converted into a congeries of cysts which leave scarcely any of its parenchyma in a normal condition (Fig. 99). The pathogenesis of this condition is hotly debated. The three favorite theories are:

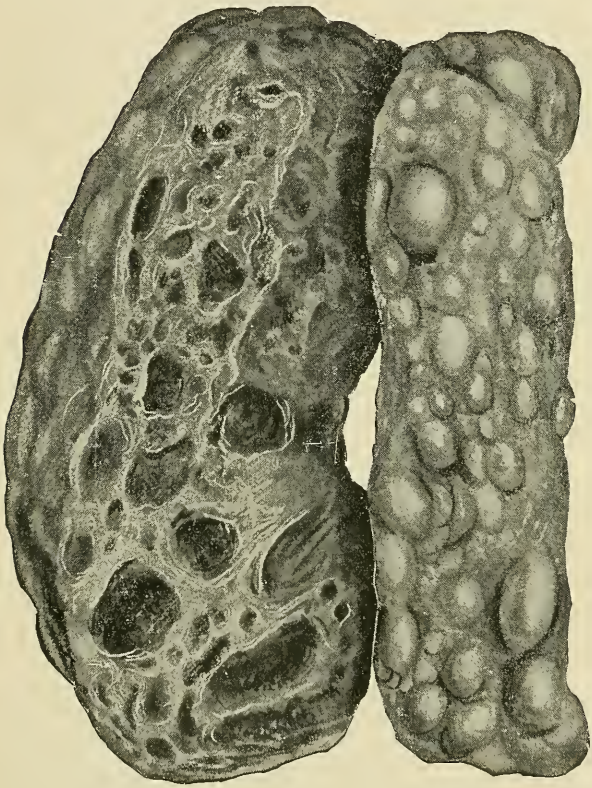


Fig. 99.—Polycystic Kidney.

1. That the cysts are incidental to a chronic interstitial nephritis. This explains the bilateral nature of the disease, but does not show why it should be associated with a similar cystic condition in other organs, notably the liver.

2. That they are the result of congenital malformation in that the kidney pelvis does not become properly apposed to the parenchyma.

3. That they are cystadenomata.

So much for the theories. From the clinician's point of view the facts, though definite enough, are equally confusing. The disease appears at all ages. In the fetus the kidneys have been known to be so much enlarged as to obstruct labor. Certain writers have endeavored to distinguish congenital cystic degeneration from that which occurs in adults, but there is no foundation for this distinction. *The condition is always bilateral.* Among 62 cases collected by Lejars only 1 was unilateral, and even in that one there was a single small cyst in the opposite kidney (Morris). Another peculiarity

[1] *Archiv f. klin. Chir.*, 1901, lxv, 112.

of the disease is the frequency with which the liver is involved. Of Ritchie's 88 cases 86 were bilateral, the liver was cystic in 21, and the thyroid gland, the uterus, and the ovary each cystic in one case.

Pathology.—The most striking feature of the fully developed cystic kidney is its size. The organ grows so large as to fill the entire lumbar region and to project anteriorly almost to the median line (Fig. 100). The disease usually progresses more rapidly upon one side than upon the other, so that one kidney may be so much enlarged as to form a visible abdominal tumor, while the other can not be palpated. The largest recorded specimen weighed 16 pounds (Hare).

Apart from its size, the most striking characteristic of this growth

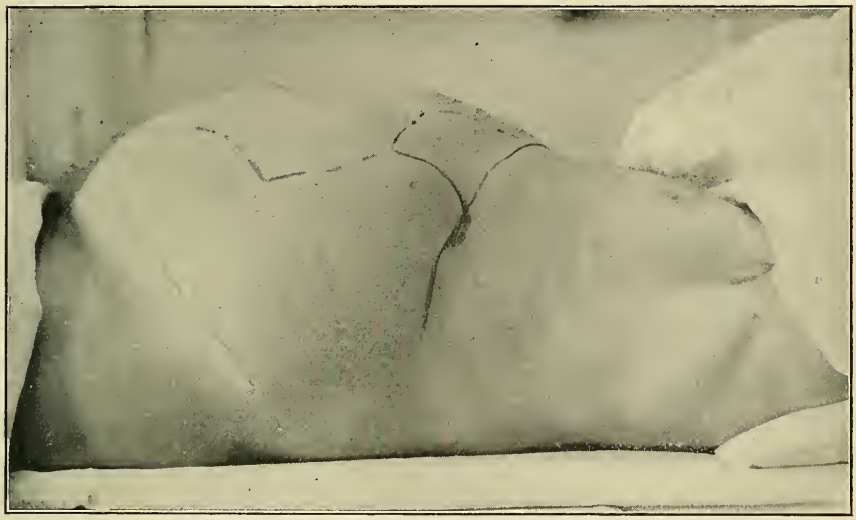


Fig. 100.—Outline of Polycystic Kidney and Spleen. Duration 8 years; death six months later. Right kidney and liver also involved.

is its irregularity of surface. When the kidney has grown to such a size as to cause a surface tumor palpation reveals the existence over the growth of larger or smaller rounded lumps, some hard, some elastic, and some even fluctuating. This characteristic irregularity of surface is all but pathognomonic of cystic disease of the kidney.

On section the cystic kidney shows an infinite number of cysts of varying sizes. With the naked eye it may be impossible to detect any normal renal tissue. The contents of the cysts are liquid, viscid, colloid, or caseous. They are usually amber-colored, rarely dark and hemorrhagic, and exceptionally suppurating. The cyst contents are not urinous, and the cysts do not communicate with the sinus of the kidney. Exceptionally calculi are found in the cysts, and in the kidney pelvis.

Symptoms.—The symptoms of the disease are habitually those of chronic interstitial nephritis, and, unless the tumor grows to such a size

as to attract attention, the disease runs its course and terminates as chronic nephritis. The urine is albuminous and contains casts. There is polyuria.

The surgical symptoms are hematuria, which occurs in 25 per cent of all cases (Newman [1]), tumor, and pain. Pyuria from secondary infection is occasionally associated with calculus.

The course of the disease is slow. Morris estimates the expectation of life at from one to ten years, although Ritchie has recorded a case living twenty-two years after the diagnosis had been made.

Diagnosis.—So rarely does the renal condition attract attention that only 5 of Lejar's 62 cases were correctly diagnosed during life. According to Morris, the tumor is discovered during life in 25 per cent of cases, and about 50 per cent complain of symptoms closely resembling those of chronic interstitial nephritis. When there are hemorrhage, pain, or pyuria and slight enlargement of the kidney this is likely to be mistaken for one of the surgical diseases of that organ.

The diagnosis can usually be made by palpation. (I was once misled by a symptomless bilateral calculous hydronephrosis. The patient dropped dead the next day.) In one of my cases radiography disclosed the cystic nature of two moderately enlarged kidneys. (The patient insisted upon pyelography, which I refused. It was done by another surgeon and caused such alarming symptoms that nephrectomy was immediately performed.) Braasch states that "the pelvic outline of bilateral cystic kidney is characterized by flattening of the calices, giving a general oval contour to the pelvis, in contradistinction to the retracted calices of tumor. Occasionally, however, a retraction of the calices may also be found with the bilateral cystic kidney, but it then is broad and open, not slit-like or narrow."

Treatment.—*Cystic degeneration of the kidney is not a surgical disease;* in its clinical aspects it is a chronic interstitial nephritis.

Rovsing [2] has had some success in temporarily relieving pain and improving kidney function in 3 cases by multiple incision and puncture of cysts until the kidney is reduced to a normal size. Lund [3] reports four cases of improvement following this operation.

Nephrectomy does not cure. Its immediate mortality is very high (33 per cent of 62 cases reported by Sieber [4]).

6. Echinococcus Cysts.—Echinococcus cysts of the kidney are rare. Houzel [5] collected the statistics of Finsen (Iceland), Thomas (Australia), Neisser, and Davaine, a total of 2,111 cases of echinococcus

[1] *Glasgow Med. Jour.*, 1897, i, 324, and ii, 42.

[2] *Am. Jour. Urol.*, 1912, viii, 120.

[3] *Jour. A. M. A.*, 1914, lxiii, 1083.

[4] *Deutsch. Zeitschr. f. Chir.*, 1905, lxxix.

[5] *Revue de chir.*, 1898, xviii, 689, 811. Cf. also Carta-Mulas, *Gaz. d. Osp.*, 1915, xxxiv, 609.

cysts in men, with only 115 (5 per cent) instances of renal echinococcus.

The cyst arises in the cortex of the kidney and grows slowly, without producing symptoms, until it reaches such a size as to form an obvious tumor, or ruptures. When left to itself the cyst habitually bursts into the pelvis of the kidney, and its contents are discharged with the urine. This occurs in 52 of the 63 cases collected by Roberts.[1] In 3 of these cases the cyst ruptured into the intestines as well, once into the stomach, once into the lungs; and of the 11 remaining cases 8 did not rupture, 2 were incised, and 1 burst into the lungs only. In only 18 of these cases was the tumor distinguished during life. Suppuration of the cyst may occur after it has ruptured. The results of rupture are not necessarily good. The cyst may for years continue to discharge without ever emptying itself.

The symptoms of the disease are lumbar tumor, growing slowly, with little fever or pain, and no constitutional symptoms. The tumor itself simulates a hydronephrosis, and the hydatid fremitus can rarely be obtained. Later in the disease rupture of the cyst is betokened by a renal colic and followed by the discharge of hydatid vesicles through the urethra.

Treatment.—Twenty of Roberts's cases recovered and 19 are known to have died. The only treatment of the disease, and often the only means of making a diagnosis, is nephrotomy. After the cyst has been incised and thoroughly washed out a cure may be expected. It is scarcely necessary to excise the entire cyst, and in a number of cases nephrectomy has proved fatal.

7. Dermoid Cysts.—Baldwin[2] has collected seven reported cases of renal dermoid cysts.

SOLID TUMORS OF THE KIDNEY

BENIGN TUMORS

Benign tumors of the kidney are extremely rare. The commonest of them is the renal "lipoma," the benign type of "hypernephroma." True lipoma and fibroma have been described.

These benign growths have no clinical features. They do not give rise to any symptoms and the diagnosis is only made post mortem. Their sole interest lies in the fact that most of them are liable to malignant degeneration.

MALIGNANT GROWTHS

Frequency.—Nine cases of primary renal tumor were recorded in 4,505 autopsies. Secondary deposits were found in the kidneys 10

[1] "Urinary and Renal Diseases," 2d Edit., Phila., 1872, p. 566.

[2] *Surg., Gyn. & Obstet.*, 1913, p. 219.

times in 126 cases of carcinoma, and 10 times in 69 cases of sarcoma. While these secondary deposits are commonly bilateral the primary malignant disease is habitually unilateral.[1] Renal growths are about equally frequent in the two sexes and on the two sides. The distribution of the disease throughout life is rather striking. Küster has tabulated 422 cases as follows:

From birth to 5 years	128
Six to 10 years	41
Forty to 50 years	125
Over 50 years	128

Thus the malignant tumors of the kidney may be considered clinically as the tumors of childhood and those of adult life. In childhood they are most common from birth to the fifth year, exceptional after the tenth year. In adults they occur most commonly between the forty-fifth and the sixtieth year.

The malignant tumors of the kidney may be divided pathologically as well as clinically into two age groups, viz., the embryomata (Wilms's tumors) of childhood and a variety of tumors, chief among which are the so-called "hypernephromata" of adult life.

Trauma and heredity have not been shown to influence tumors of the kidney while nephritis, suppuration and stone are accidental and secondary rather than primary. (Though epithelioma secondary to stone has been noted.)

Tumors	Cases	
	Wilson	Watson
"Hypernephroma"	71	45
Hypernephroma of the adrenal	2	4
Papillary adenoma [2]	—	4
Papillary cystadenoma [2]	—	11
Sarcoma	7	2
Carcinoma	4	3
Fibroma	1	14
Lipoma	—	5
Embryoma	3	—
Epithelioma of the pelvis	1	—
Papilloma of the pelvis	3	1
Totals	92	89

[1] Wagner (*Folia Urol.*, 1912, vi, 619) reports a case with primary tumors in each kidney and quotes Küster's statistics which showed post mortem 42 (out of 261) cases of metastasis of a renal tumor in the opposite kidney.

[2] Should doubtless be classed with "hypernephroma."

The relative frequency of these tumors may be roughly estimated from the preceding table (p. 486) made up of reports by Watson and Wilson.[1]

Embryoma.—The renal tumors of childhood were usually spoken of as sarcomata, adenosarcomata or mixed tumors until properly classified by Wilms.[2] These tumors, like most other malignant growths, re-

FIG. 101.—ADENOCARCINOMA OF THE HYPERNEPHROMA TYPE.

main relatively incapsulated within the kidney, so that one usually finds portions of renal tissue uninvolved in the growth even after this has reached twenty pounds' weight. Like other embryomata these growths are mixed in character, and, while the sarcomatous elements predominate, especially in the large tumors, areas resembling carcinoma and bits of enchondroma, osteoma, etc., can be found in the growth unless these have been overrun by the more malignant tissue. These

[1] *Ann. of Surg.*, April, 1913.

[2] "Mischgeschwuelste der Niere," Leipzig, 1899.

growths extend by lymphatic continuity into the perirenal tissue and by venous metastasis. They reach an enormous size.

"**Hypernephroma.**"—The propriety of this title has been gravely questioned of late years. But inasmuch as they are widely known under this name, and as the pathologists have not yet reached any unanimity in their interpretation of the nature of these tumors, we may still continue to call them "hypernephromata." They destroy life before reaching anything like the size often attained by the tumors of infancy; but like them they usually occupy only a portion of the kidney even after they have extended into the vessels and the perirenal tissue. The early pathologists described them as malignant lipomata because, in their growth as well as in their microscopic characteristics, they show a certain resemblance to fatty tumor. Grawitz, however, gave them the name of "hypernephroma" after showing that their structure closely resembles that of the tumors of the adrenal glands. He inferred that they were due to adrenal inclusions,[1] within the kidney, such as have occasionally been found.[2] Of late years this theory has been questioned by various writers, notably by Wilson, who maintains that they are "mesotheliomata derived from the nephrogenic vesicles which had failed in the early embryo to form a tubular connection with the renal pelvis." Others are satisfied to classify them simply as carcinomata.

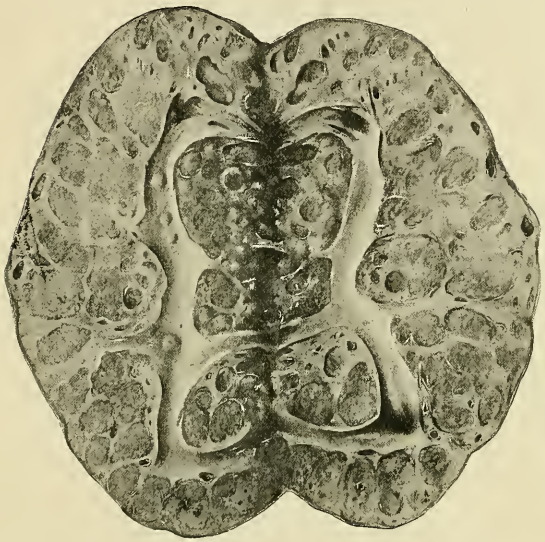


Fig. 102.—Carcinoma of the Kidney.

The striking microscopic characteristic of these growths is their great variety of structure. In places they exhibit a structure which suggests the cortex of the adrenal gland; they are very vascular, indeed, as Watson remarks, their stroma may be said to be formed of capillaries, so that in places they suggest angiosarcoma and endothelioma. The cells are polygonal or columnar in shape, and their large lightly staining

[1] *Ann. of Surg.*, April, 1913.

[2] Dunn (*Jour. Path. and Bacteriol.*, 1913, xvii, 515) classifies them as (1) true adrenal rests, (2) adenopapillary tissue and (3) papilliferous cysts.

bodies have given rise to the French title "carcinoma with clear cells." With the breaking down of certain parts of the tumor one may see pictures absolutely characteristic of papillary cystadenoma;[1] while other specimens show a narrow tubular development which has suggested the title "adenoma." The larger cells often contain fat or become vacuolated when this disappears. The larger tumors usually show a necrotic center.

Carcinoma.—Perhaps the above tumors are but one form of renal carcinoma. There is, however, a rare clinical type of carcinoma, usually an adenocarcinoma, which involves the whole of the kidney (Fig. 102).

Sarcoma.—Spindle-celled, round-celled, and mixed sarcomata are described. The latter are actually embryomata, but the spindle and round-celled varieties, though rare, usually occur in adult life. Wilson states that "most of the few true sarcomata of the kidney develop primarily in adult tissue of the renal capsule and involve the cortex secondarily."

Other Tumors.—The papillary cystadenomata are doubtless all variants of the "hypernephroma," so are the adenomata, benign or malignant.

Tumors of the Renal Pelvis.—See page 493.

Symptoms of Malignant Growths

The symptoms of renal tumor are:

Hematuria.	Urinary symptoms.
Tumor.	Compression symptoms (varicocele).
Pain.	General symptoms.

Hematuria.—*Hematuria is usually the first symptom of renal tumor in the adult.* This was the first symptom in 138 out of 257 cases studied by Albarran.[2] Hematuria occurred during the course of the disease in 235 out of 357 cases.

The hematuria is characteristically abundant, painless, spontaneous, and not influenced by motion or rest. Renal colic may result from the passage of clots through the ureter. These clots may sometimes be discerned in the urine by their wormlike shape. The bleeding may be so free that the blood only clots after reaching the bladder. *I have seen four cases that required catheterization to free the bladder of clots.*

The hematuria may occur many years before any other symptom. Thus Hildebrand has reported cases in which the intervals between the appearance of blood and any other symptom of tumor were eight to twelve years. The hematuria may be so profuse as to cause grave anemia.

[1] Cf. Kretschmer, *Surg., Gynec. and Obstet.*, 1914, xix, 766.

[2] "Les Tumeurs du Rein," Paris, 1903.

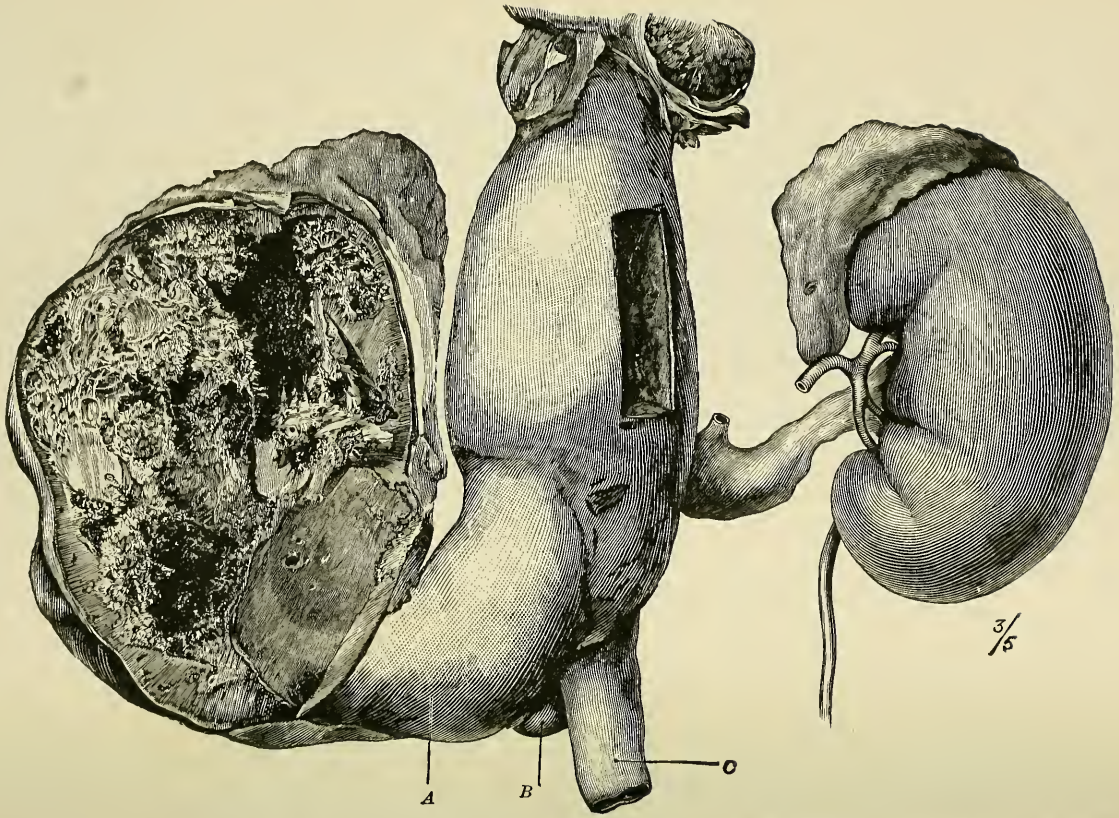


FIG. 103.—SARCOMA OF KIDNEY INVADING THE VENA CAVA (Morris). A, sarcomatous renal vein; B, sarcomatous gland; C, vena cava.

In children hematuria is much rarer than in adults. Albarran found it only 22 times in 140 cases.

Renal Tumor.—Renal tumor, accompanied by little or no pain, is usually the only symptom of renal neoplasm in children until the cancerous cachexia begins to show itself.

In adults, a tumor is usually discernible at the time of operation. Albarran's statistics show only 53 cases out of 257 in which tumor was the first symptom.

Pain.—Pain was one of the first symptoms of renal tumor in the adult in 91 of Albarran's 257 cases, and occurred during the course of the disease 134 times in 303 cases. Pain is usually, but not always, felt exclusively in the loin.

Urinary Changes.—The urinary changes consist usually in a diminution of renal function, the presence of albuminuria, and sometimes of microscopic hematuria or of blood casts. Pus is rare.

Unfortunately *a renal tumor may exist for several years without impairing the renal function.* Thus in one of my cases three years after the initial hematuria radiography showed that the kidneys were of equal size and the urine from the diseased organ showed a water and urea output equal and the phenolsulphonephthalein output superior to that of its fellow. The patient died two years later.

Compression Symptoms.—The nerves, the ureter, and even the intestine may give compression symptoms from the presence of a large renal growth. The important symptom, however, in this connection is *varicocele.* Strikingly large varicocele is sometimes one of the symptoms of renal tumor—evidence of compression of the spermatic vein. It is more common on the left side than on the right, and Legueu believes that the presence of varicocele is evidence that the renal vein is compressed by enlarged lymph glands. According to this thesis, varicocele would be almost a contra-indication to operation; but Albarran and others have shown that there may be marked glandular enlargement without varicocele, marked varicocele without glandular enlargement. I have encountered varicocele but once. The cava was invaded by the growth. The patient survived nephrectomy four years.

Fever and Cachexia.—Israel [1] has seen intermittent and relapsing fever in 18 cases of renal and adrenal tumor. It may be an early and misleading symptom. The cachexia of renal tumors differs not at all from that due to malignant growths elsewhere.

Clinical Types

Albarran recognizes the four following clinical types:

1. The adult type, characterized by hematuria and tumor.

[1] *Deutsche med. Wochenschr.*, Jan. 12, 1911.

2. The hematuric type without tumor.
3. The tumor type without hematuria (the common type among children).
4. The painful type.

Diagnosis of Malignant Renal Growths

The diagnosis presents itself under two phases:

1. When tumor is absent.
2. When tumor is present.

Diagnosis in the Absence of Tumor.—If no tumor can be felt in either kidney region, the symptom that leads to the suspicion of renal tumor is *hematuria* (*pain,* however, was the initial symptom in 27 of Braasch's[1] 83 cases; the only symptom of 14)—hematuria, painless, spontaneous, profuse, and total (i. e., not terminal hematuria). The fact that the blood clots in the bladder is no evidence against its renal origin.

Cystoscopy and ureter catheterism determine whether this hematuria occurs in the bladder or descends from the ureter of one or the other kidney. The cystoscopy should be performed while the patient is bleeding.

The question then arises, is the hematuria of the so-called essential type, or is it due to neoplasm?

Unfortunately renal tumors so small as not to be palpable are usually surrounded by a considerable amount of normal renal tissue; hence the impairment of function on the afflicted side may be insignificant. *This constitutes one of the greatest dangers in the diagnosis of renal hematuria.*

Under such circumstances pyelography should be employed. This, too, may fail to show recognizable abnormality. (It failed in five of Braasch's 22 cases.) In this event *exploratory nephrotomy is indicated if the patient is over 35 years of age.*

Diagnosis in the Presence of Tumor.—When the renal neoplasm has attained sufficient size to be palpable, the fact that it is in the kidney and not in one of the surrounding organs may usually be determined by the functional renal tests, although in young children these are usually not applicable, and one must depend upon the physical characteristics of the tumor in the loin.

The presence of a large tumor in the loin of the child almost invariably means malignant growth in the kidney.

Renal tumor may be differentiated from cystic disease by radiography and pyelography; from other retroperitoneal growths by renal function tests and pyelography.

[1] *Jour. A. M. A.,* 1913, lx, 274.

Treatment

The only treatment is nephrectomy. This should always be attempted unless the cachectic condition of the patient or functional deficiency of the opposite kidney forbid.

The very peculiar features of nephrectomy for tumor are dwelt upon elsewhere (p. 698).

Under modern conditions the mortality of nephrectomy for tumor is little more than that for tuberculosis. The Mayos lost but seven out of 61 nephrectomies. But recurrence is frightfully common. Among the Mayos' cases 27 died in from one to five years and 27 were last reported alive. But of these only 12 had been followed three years, only five more than five years. Of my own nine cases two were fixed. The attempt to remove them was fatal. Of the others only three were fairly confined to the kidney. Two of these survive, apparently well, one and three years after nephrectomy. The others died of recurrence.

Tumors of the Renal Pelvis and Ureter

The tumors of the renal pelvis and ureter are epithelial in character. Stuesser[1] has collected the reported cases: 47 malignant papillomata, and 11 epitheliomata. The tumors originate in the renal pelvis, and are occasionally propagated down the ureter and into the bladder. Lower[2] reports a case of malignant papilloma extending from the pelvis of the kidney to the bladder, and has collected 18 similar ones.

The papillary tumors are of the same character as those of the bladder, the epitheliomata are alleged to be due to leukoplakia or similar inflammatory changes causing the epithelium of the kidney pelvis to become squamous in type. They may be secondary to stone.

The secondary pathological changes are due to obstruction of the ureter by the growth or by clots which result in hematonephrosis.

The *symptoms* are: bleeding, renal colic and the development of a tumor in the side.

The *diagnosis* is made by cystoscopy which reveals blood coming from the kidney involved. It will be impossible to make a correct diagnosis before operation unless the growths have been propagated to the lower end of the ureter and bladder.

The treatment is ureteronephrectomy with removal of the duct down to the bladder wall, and either fulguration or excision of the adjoining bladder wall for the treatment of the vesical tumors.

Although Israel has insisted upon the importance of suspecting tumor of the kidney pelvis in all cases of bladder papillomata, the com-

[1] *Beitr. z. klin. Chir.*, 1912, lxxx, 595.

[2] *Surg., Gyn. & Obstet.*, Feb., 1914, 151.

bination of the two conditions is extremely rare. I have endeavored to excite hemorrhage from growths in the ureter by rather roughly passing ureter catheters up and down these whenever I had occasion to fulgurate a bladder papilloma lying near the ureter orifice; but I have never yet succeeded in thus obtaining any suggestion of tumor of the ureter.

CHAPTER LII

TUMORS OF THE BLADDER AND URETHRA

TUMORS OF THE BLADDER

The great majority of tumors of the bladder are of epithelial origin; thus I have personal records of 84 cases of papilloma and carcinoma with no other varieties represented, excepting a single lymphadenoma. Young [1] records 117 cases of which 96 were carcinomata, 21 papillomata, and 1 sarcoma. Among the rarer tumors one may mention sarcoma, myoma, angioma, and epithelioma and adenoma. Epithelial, dermoid and hydatid cysts have also been observed.

ETIOLOGY

Little is known of the etiology of tumors of the bladder. Irritation plays the important part in only two tumors—the epitheliomata, which arise from areas of leukoplakia, and the tumors occurring in the bladder of persons working in anilin dye factories [2] which have been shown to be due to the irritation of the urine caused by inhalation of the irritating fumes.

Carcinoma of the bladder is extremely rare in patients under forty years of age. Papilloma (as judged by my standard) is almost always benign under fifty; yet Hadda,[3] who states that in a series of 5,000 carcinomata less than 1 per cent was located in the bladder, and none occurred in patients under twenty, nevertheless described a case apparently due to the irritation of stone which had been removed when the lad was nineteen years of age. The carcinoma appeared 5 years later.

Seventy-eight per cent of Albarran's cases were in men, and Judd [4] records 84 cases in men to 30 in women.

PATHOLOGY

Papilloma.—This neoplasm has been gracefully described by Thompson [5] as follows:

[1] *Jour. Am. Med. Assn.*, 1913, lxi, 1857.

[2] *Jour. Am. Med. Assn.*, 1900, xxxiv, 1256; also *Beitr. z. klin. Chir.*, 1912, lxxx, 206.

[3] *Arch. f. klin. Chir.*, 1909, lxxxiii, 3.

[4] *Jour. Am. Med. Assn.*, 1912, lix, 1788.

[5] "Tumors of the Bladder," London, 1884.

The most obvious characteristic of the growth is a structure in which the vesical mucous membrane is developed into fine papillae, which consist of long fimbriated processes of extreme tenuity, and usually form a group arising from a small circumscribed base (Fig. 106). This last-named part contains other and more solid structure than that which enters into the papillae themselves. Sometimes the processes are almost single, threadlike forms arranged side by side, and undivided for a considerable distance; others are bifid, generally more compound still; some may be described as digitate, and occasionally the processes radiate and suggest forms resembling those of leaves. Immersed in fluid, the long fimbriated growths float out like slender-leaved aquatic plants in deep water, and when removed to air collapse and form a soft mass resembling a small strawberry.

The villi are composed of capillary loops covered by several layers of columnar epithelium (Fig. 104). The "more solid structure" of the pedicle is fibrous and vascular. Independent villi may spring from the wall of the bladder itself, or the pedicle may be short and broad, giving the growth a sessile appearance (Pl. I).

The *pathological diagnosis* of papilloma is beset with the greatest difficulty. That a bladder tumor conforms grossly and even microscopically to the papilloma type is no proof that its complete removal will not be followed by relapse either in the form of papilloma or of carcinoma. Indeed I have known a competent pathologist to pronounce the original tumor carcinoma, the recurrence papilloma, nor did confrontation alter his either opinion. So frequent is recurrence of papilloma (estimated by Rafin[1] at 57 per cent) that we may still echo Guyon's aphorism, "We await in the clinic the papilloma of statistics"—for in the clinic *papilloma of the bladder is often a malignant growth,* even when the microscope reveals no malignancy about it. Nevertheless certain pathologists persistently cling to the hope of microscopic diagnosis of papilloma that may show some agreement with the clinical facts. Thus in the symposium of the American Urological Association in 1915 Buerger stood out absolutely for the sufficiency of microscopic diagnosis while Geraghty granted it fallible. This skepticism seems justifiable. We may recognize a type of obviously benign papilloma, single, pedunculated, readily destroyed by cauterization; a malignant papilloma, occurring almost exclusively after the fiftieth year, often multiple, sometimes ulcerated, slow to heal by burning; and a papillary carcinoma with infiltrated base. Microscopic examination of these growths gives a fairly consistent picture. In papillomata the characteristics of malignancy are summed up by Buerger, as follows:

Cells manifesting irregularities in size and shape; nuclei rich in chromatin, deeply staining and of bizarre shape; cells with atypical mitoses; giant cells

[1] *French Urol. Assn.*, vol. ix.

and multi-nucleated cells. All these, when occurring in papilloma of the bladder, indicate the presence or beginning of carcinomatous change.

On the other hand, certain of the atypical appearances noted in papillomata are not to be regarded as indicative of malignancy. Some of these are degenerative, others metaplastic. There may be, first, the formation of

FIG. 104.—PAPILLOMA OF BLADDER.

glands or cysts, the conversion of the epithelium into cylindrical and cuboidal epithelium with the acquisition of the property of secretion; second, intense inflammatory invasion with round cells, infiltration of the epithelium with fine fusiform cells, probably angioblasts; third, conversion of some of the cells into squamous cells, such as are within the normal type of cell.

Carcinoma.—Not only do we see tumors illustrating every step from the simple papilloma to the papillary carcinoma, but many observers are not unwilling to admit the actual metaplasia of tumors from one to the other. The prolonged histories of certain cases that ultimately prove to be microscopically, pathologically and clinically carcinoma; the occurrence in different parts of the bladder of typical carcinoma,

and typical papilloma and the recurrence after operation of papilloma as carcinoma or carcinoma as papilloma;—by all these tests either the microscope is not to be depended upon at all, or true papilloma does change into true carcinoma in the bladder.

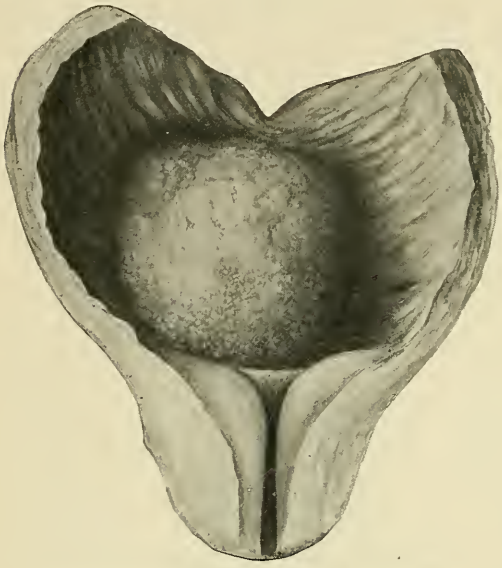


Fig. 105.—Carcinoma of the Bladder.

In its gross characteristics, carcinoma of the bladder presents three types: the papillary carcinoma (Fig. 106) with infiltration of its base and surrounding mucosa; the lobulated carcinoma (Fig. 107) which, while it may appear superficially a papilloma, does not yield to fulguration, is likely to be ulcerated, to have a broad base, and to show some infiltration about this base; and the carcinomatous ulcer. The diagnosis of such tumors, however, must be made primarily by the removal of a specimen which shows typical fully developed carcinoma. The carcinomatous ulcer is

Fig. 106.—Papillary Carcinoma. (Albarran)

Fig. 107.—Lobulated Carcinoma. (Albarran.)

not an ulceration or incrustation of a lobulated or villous growth, for this may occur with either of the two types already mentioned. It has rather the gross characteristics of the epithelioma of the lip. It is a hard indolent ulcer without any tendency to papillary outgrowth.

With the first two types of tumor there is a distinct tendency to surface implantation and multiplicity, the secondary tumors being sometimes apparently wholly papillomatous; but the carcinomatous ulcer is characteristically single and its microscopical characteristics verge toward the epithelioid type.

Other Types of Epithelial Neoplasm.—A number of authentic cases of colloid or mucous carcinoma of the bladder have been reported.[1] Since there are normally no glands in the bladder, these tumors must arise either from glandular inclusion or, as seems more probable, from degeneration of a patch of cystitis granulosa.

Cases of adenocarcinoma are reported from time to time, and may have a like origin, but most of them are secondary to carcinoma of the intestines.

True epithelioma seemingly always arises from leukoplakia, and shows itself either by a propagation of this condition or by an ulceration thereof.

Cystitis cystica might almost be classed among the neoplastic conditions of the bladder for it is not infrequently found with carcinoma (Fig. 70).

Propagation.—Papilloma is apparently propagated only by contact inoculation. Carcinoma is propagated in three ways: (*a*) by contact inoculation, (*b*) by infiltration of the surrounding tissues, and (*c*) by lymphatic involvement.

Contact inoculation occurs in two ways. Either the growth appears at various points in the mucosa that fall against each other when the viscus is empty, or postoperative relapse occurs in the suprapubic scar (due to inoculation at the time of operation).

Lymphatic involvement carries the carcinoma to the iliac glands and thence to the lumbar glands.

Pasteau [2] has shown that the glands along the iliac vessels are enlarged in 43 per cent of all sessile tumors of the bladder and in 85 per cent of infiltrated tumors.

Secondary Lesions.—Any tumor of the bladder may also become inflamed, ulcerated, or incrusted with salts of lime. Perforation of the bladder is most exceptional.

The secondary changes in the urinary organs are of greater importance. The tumor acts in very much the same way as a hypertrophied prostate. It offers a point of least resistance for the origin of infection, and, sooner or later, it obstructs the orifice of the urethra or of the ureter, thus setting up the secondary retention with infection, pyelonephritis, etc.

[1] Chute and Crosbie, *Boston Med. & Surg. Jour.*, 1912, clxvii, 583.

[2] "État du système lymphatique dans les maladies de la vessie et de la prostate," Paris, 1898, pp. 46, 52.

Other Tumors.—The other tumors of the bladder are not sufficiently frequent to require more than a summary consideration.

Sarcoma.[1]—Round-celled, spindle-celled, mixed-celled, lymphosarcoma, fibrosarcoma, myosarcoma, myxosarcoma, alveolar, giant-celled, telangiectatic, and chondrosarcoma are described. The tumor usually encroaches but little on the cavity of the bladder. It appears either as a hard sessile growth or an intramural infiltration. Its surface may be smooth, papillary, or ulcerated.

Myxoma [2] *(Polyp).*—Myxoma occurs only in children. The growth is usually a fibromyxoma or a myxosarcoma. The surface of the tumor is lobular and smooth, resembling polypus of other regions.

Myofibroma.[3]—The tumor being benign, usually small, and of firm texture, passes unnoticed during life, unless it interferes with micturition, becomes infected or ulcerated.

Angioma.—This has been well described by Albarran.[4] It has no clinical significance.

Cysts.—Several varieties of cysts occur in cystitis. They have no clinical significance. Urachus cysts receive special consideration at the end of this chapter.

Dermoid cysts occasionally occur in the wall of the bladder. They are diagnosed only when, after rupture, hair from them is passed in the urine. This symptom, pilimiction, is pathognomonic.

Echinococcus cysts [5] grow in the pelvis and burst into the bladder.

SYMPTOMS

Epithelial Tumors

Hemorrhage.—The first, the last, and often the only symptom of a tumor of the bladder is hemorrhage. In general, the more villous the tumor the more profuse the bleeding. Hence, with such tumors as myofibroma, hemorrhage is rare.

The characteristic hemorrhage of a neoplasm, whether renal or vesical, begins without cause or warning, continues copious and painless, unaffected by rest, diet, or medication, and ceases, as it begins, without apparent rhyme or reason. Its cessation may leave the urine entirely normal and the patient lulled into a false sense of security by what he considers his happy escape from a perilous condition. A profuse hemorrhage of this character is almost pathognomonic of neoplasm. Yet bleeding from a tumor may not be characteristic. It may be mild and

[1] Munwes, *Zeitschr. f. Urol.*, 1910, iv, No. 11.
[2] O'Neill, *Trans. Am. Urolog. Assn.*, 1915, ix, 1.
[3] Blum, *Folia Urol.*, 1910, v, 314.
[4] "Tumeurs de la vessie," 1891.
[5] Salvador, *Semana med.*, 1912, xix, 449.

continuous, associated with cystitis, evoked by instrumentation, or apparently amenable to treatment. It may not be the initial symptom. In short, it may assume any form. But to be characteristic it must be spontaneous, profuse, unalterable, and unaccompanied by any other symptom.

Usually the hemorrhage grows more severe and recurs more frequently as the disease progresses. But this is by no means always the case. There may be intervals of years between the hemorrhages; indeed, Albarran cites a few cases in which the hemorrhage stopped entirely after spontaneous detachment of the growth.

Hemorrhage from neoplasm of the bladder may be excited by the introduction of any instrument (especially a metal one) into that organ, and when thus produced it assumes its characteristics of profusion, painlessness (except for the passage of clots), resistance to treatment, and spontaneous cessation.

Pain and Dysuria.—These symptoms usually appear long after the first hemorrhage. Exceptionally, pain and dysuria precede the bleeding. I have seen three papillomata that did not bleed, but gave rise solely to the symptoms of cystitis. Pain may be evoked by the passage of clots; it may be due to cystitis, to obstruction of the urethra, or to the infiltration of the bladder muscle by the tumor itself.

Retention.—The passage of urine may be suddenly arrested by a large clot or by the tumor. All the familiar forms of acute and chronic retention, with or without infection, are encountered. Tumors in the region of the ureteral orifice sometimes obstruct that duct partially or completely.

Cystitis.—The course of the disease is commonly divided into two stages: (1) before infection, (2) after infection. Yet cystitis may be the first symptom of tumor. The tumor is a point of least resistance. Instruments introduced into the bladder often bring infection with them, and thus in one way or another, at one time or another, cystitis occurs. When once the tumor has become inflamed there is little hope of overcoming the inflammation except by removing the tumor; and if this is not done early the inflammation spreads to the kidney, and is largely instrumental in the patient's final taking off.

The cystitis of tumor of the bladder is usually ammoniacal and leads to incrustation. The dysuria is severe, and small quantities of foul urine full of pus and blood are passed with infinite pain and straining.

Course of the Disease

Among 140 cases collected by Albarran the *first symptom* was hematuria in 109 (78 per cent), dysuria in 10 (7 per cent), cystitis in 5, frequency in 5, and in the remainder, various combinations of

hemorrhage (in 10), dysuria (in 7), cystitis (in 2), retention (in 2), the passage of shreds, and once the extrusion of the tumor from the female urethra.

Before infection occurs, the symptoms are mild. Indeed they are all too mild. For if we may judge from their size some tumors—even carcinomata—exist for years without causing symptoms. Were it not for the hemorrhages that occur from time to time, the patient would give little thought to his urinary organs. These hemorrhages, though profuse, rarely cause any grave anemia. This condition continues for months or years. The patient's general health is excellent, and he may bear his bleeding in silence and come to the surgeon only after cystitis has set in.

When cystitis occurs the symptoms promptly become more aggravated, and the patient, exhausted by the loss of blood and distressed by the constant spasm of his bladder, grows rapidly weaker.

The Urine.—The appearance of the urine depends upon whether cystitis or hemorrhage is present at the time of examination. Between whiles it may be entirely normal, or there may be microscopical and chemical evidence of hemorrhage—viz., the presence of red blood cells and albumin.

When cystitis exists there is commonly some hemorrhage as well, so that the urine contains both pus and blood.

The urine may also be searched for shreds of tumor tissue. These are especially common with papillomatous growths. They sometimes are as large as a pea, resemble blood clots in appearance, and are easily overlooked. If found, they confirm the diagnosis of tumor, but do not denote the character of the growth, since simple papillae may sprout from a carcinoma.

Other Tumors

Fibromyomata, which may occur at any age, usually give no symptoms whatever; they may ulcerate and cause hemorrhage, they may mechanically interfere with the emptying of the bladder and cause retention, and thus cause cystitis. Inasmuch as these neoplasms are not malignant their course is essentially slow.

The other malignant tumors of the bladder, sarcoma and myxoma (though the former may occur in adult life), are essentially the tumors of childhood, and relatively frequent in the first years of life, up to the fifth year. The clinical picture is, therefore, singularly obscure, the symptoms of cystitis with hematuria and retention of urine are often mistaken for stone. The growth is sometimes discovered by cystoscopy, but usually only by external examination when it has reached a very large size. O'Neil[1] comments upon the bad prognosis of the

[1] *Trans. Am. Urol. Assoc.*, 1915, ix, 1.

tumors of childhood. He mentions three recoveries of at least one year after removal of polypi.

DIAGNOSIS

The majority of bladder tumors are discovered by cystoscopy after their presence has been suggested by a typical hemorrhage. Of the remainder some are discovered by cystoscopy undertaken for frequent and painful urination and pyuria, without any idea that the tumor is the cause of this; others are discovered accidentally before they have begun to cause symptoms and the remainder are disclosed by other methods of examination after they have reached a size which precludes the possibility of successful treatment.

The cystoscope is, therefore, the only method of diagnosing tumors of the bladder at a time when they are worth diagnosing, and capable of being treated.

Unwillingness to submit every case of hematuria to instant cystoscopy is the cause of our bad record in the treatment of bladder tumors.

No characteristics of the blood itself, no presence of large clots or small clots, determines the diagnosis.

A carcinoma that has grown to a considerable size and infiltrated the bladder wall may perhaps be felt either by the stone searcher inside the bladder, or as an induration in the base of the bladder by rectal touch, or even if it is sufficiently large by bimanual palpation; but such large tumors present not the remotest hope of cure.

Cystoscopic Diagnosis.—The cystoscope may leave one in doubt as to the presence of tumor in the bladder under two conditions: in the first place, when the tumor is too small; in the second, when it is too large.

The small pedunculated tumor, especially if situated in an unusual part of the bladder, may entirely escape the cystoscopist. I have once overlooked a bladder tumor of this character; indeed I have seen an infiltrating carcinoma of the bladder vault the size of a trade dollar that had eluded two cystoscopic examinations. The mistake can usually be avoided by careful observation of the region where the bladder tumors usually grow. These are:

1. The regions about the ureter orifices, especially just beyond and outside of them;

2. The vault, where carcinoma is not uncommon;

3. The bladder neck and that part of the vault just above this as well as the adjacent portions of the deep urethra. Papillomata are rare in other parts of the bladder. If they extend to the fundus and vault, they usually do so to one side or the other of the median line; thus suprapubic section for papilloma of the bladder, while it may encounter tumors in the median line at the point where the bladder is

divided, shows that the central portion of the fundus is relatively clear, and that the papillomata tend to implant in two parallel bands, running anteroposteriorly from the region of the ureter mouth.

Small carcinomata have usually the same distribution, though the epitheliomatous ulcer is more likely to occur in the midline, either of the fundus or of the vault.

The large tumor is difficult to diagnose by the cystoscope, not on account of its size, but because of the severe cystitis with which it is often accompanied. Cystoscopy may be practically impossible, or if performed, may reveal a bladder that will hold but a few teaspoonsful of urine, and the walls of which are intensely inflamed, and covered with phosphates, or slough. Under these circumstances, one may well remain in doubt as to whether one is dealing with a carcinomatous growth, an incrusted simple ulcer, or a stone covered with slime and blood. A decision may be reached by tapping the "stone" with the end of the cystoscope, or by excising a specimen with the cystoscopic forceps.

The cystoscopic forceps is used as a routine measure by some operators for the diagnosis of the exact nature of all tumors of the bladder. I have protested against its routine use on the ground of possible dissemination of tumors. There seems to be no unanimity among pathologists, however, as to whether this is a real danger or not. It is certainly no danger when there is already ulceration of a growth. But if the pathologist, with the whole tumor in his hand, cannot say whether it will be for all time a carcinoma or a papilloma, he certainly cannot do so from the small specimens that can be removed by forceps.

The cystoscopist should endeavor to make his diagnosis on the clinical features of the tumor as revealed to the cystoscope. This he can usually do with almost absolute certainty. If there is any doubt in his mind, then let him by all means take specimens from the growth in order to clear up that doubt as rapidly as possible; for it is these clinically doubtful but pathologically malignant growths that are the only carcinomata of the bladder we can expect to cure.

In the majority of instances, therefore, the cystoscopist shall depend upon his eye for a diagnosis. The ultimate criterion of that diagnosis shall be whether the tumor can be destroyed by fulguration or not. For while recognizing the malignancy, or potential malignancy, of every epithelial tumor of the bladder, we draw the line here as elsewhere in the body on the basis of treatment. The tumor that can be readily cured by treatment is not malignant. *The success or failure of the fulguration treatment of papillary tumors of the bladder determines their malignancy.*

Contra-indications to Cystoscopic Fulguration.—Some years ago I endeavored to lay down rules for this clinical distinction, and further

experience has not materially changed my opinion. The four contra-indications to cystoscopic desiccation are:

1. Hardness of the tumor.
2. Intractable cystitis.
3. Sloughing or ulcerated tumor.
4. Multiplicity and size of tumors.

Some of these contra-indications are not absolute, and all may be elucidated by a few words of description.

Hardness of Tumor.—The hardness of a vesical tumor may be appreciated in several ways. Rectal or vaginal touch may reveal an induration in the region of the trigone; bimanual palpation may disclose the presence of a large infiltrating tumor; or cystoscopy may reveal an ulcerated indurated carcinoma. All such conditions, we repeat, contra-indicate cystoscopic treatment.

Intractable Cystitis.—In the four years since Beer introduced the desiccation treatment, I have never seen a case with intractable cystitis that was suitable for intravesical treatment. The patients suffering from relatively benign papilloma may, it is true, suffer from time to time the most intense cystitis. But this can be relieved by the ordinary bladder irrigations to the point of ameliorating the patient's suffering, and permitting fulguration.

But the real intractable cystitis is not appreciably relieved by any local application; is only intensified by the introduction of the cystoscope; permits only the most inadequate and unsatisfactory observation, and of itself almost prohibits treatment. Such a case when operated upon will be found to have either a sloughing carcinoma, or some condition other than tumor.

Sloughing or Ulcerated Tumor.—A tumor that shows upon its surface any extensive sloughing is truly malignant. However, the mere presence of small sloughs does not forbid all hope of success by cystoscopic treatment. Here, then, the contra-indication is not absolute. Let the cystoscopist, however, proceed with caution, and if a few treatments do not manifestly control the growth, let him waste no further time, but quickly have recourse to the open operation.

Multiplicity and Size of Tumors.—The contra-indication here is even less definite than that of sloughing. Multiplicity of tumors is a perfectly obvious suggestion of malignancy. Such malignancy may be of two types. The multiple papillomata either spring from an underlying carcinoma (e. g., an infiltration from the cervix uteri) or are propagated by surface contact. In the latter case the malignancy is a superficial one. Indeed, a very large proportion of bladder papillomata are multiple when first seen. Yet a majority of these are certainly amenable to treatment by fulguration.

Size and multiplicity of tumors, therefore, present a problem in

practical surgery rather than a question of malignancy. Every urologist must decide, in the light of his own experience, whether it is more profitable to cut or to burn a given patient. It so happens that only one of my cases has defied treatment on account of the size or multiplicity of growth. Yet no doubt some of these might have been more quickly cured by the knife. It is noteworthy that though I have verified a cure by cystoscopy ten times, a year or more after the last treatment, none of the ten had more than two tumors when treatment was begun. Three others with multiple tumors (5, 5, and 7) were clean when last seen; but doubtless they will relapse again.

In a certain sense the patient's age bears on the question of malignancy. Thus among my cases there were eighteen with single tumors, of whom all but four showed symptoms before the age of fifty. On the other hand, of the nine with multiple tumors, all began after the fiftieth year.

Failure of Cystoscopic Fulguration.—But in order to do justice to his patients the urologist must be quick to recognize, not only the contra-indications to an attempt at fulguration, but also the evidence of failure in this treatment. He is dealing with a growth which is at least potentially malignant. Perhaps the very days during which he is making up his mind as to the advisability of fulguration are those during which the tumor is actually spreading to the pelvic lymph nodes, thus making a curable case incurable. The fear of carcinoma must be ever in his soul, and a tumor, however small and apparently superficial, that resists fulguration must be promptly excised.

Pseudocarcinoma

It is doubtless unnecessary at this date to insist upon the chronic infiltration of the mucosa about the base of the tumor following fulguration. It simulates an infiltrating carcinoma. It may persist for at least three months, as in Cabot's case, and our only safeguard against it is the knowledge that it was not there when we began treatment, and that it may persist for several months after the last burn.

The only serious complication of such an ulcer is staphylococcus infection causing phosphatic incrustations. Such a complication I have seen but once.

PROGNOSIS

Thus the prognosis of papilloma grows worse the older the patient afflicted, while the prognosis of carcinoma grows worse the younger the patient afflicted; for here, as elsewhere, carcinoma in the young usually grows with great rapidity. Beyond this the prognosis is quite indefi-

nite. One of my patients bled for twenty-five years before I burned off his single tumor quite readily in three or four treatments; he has remained well for three years since that time. Others come after their first bleeding with a bladder full of tumors, or with a carcinoma so far advanced as to be irremediable.

The prognosis after treatment is, perhaps, the most important point.

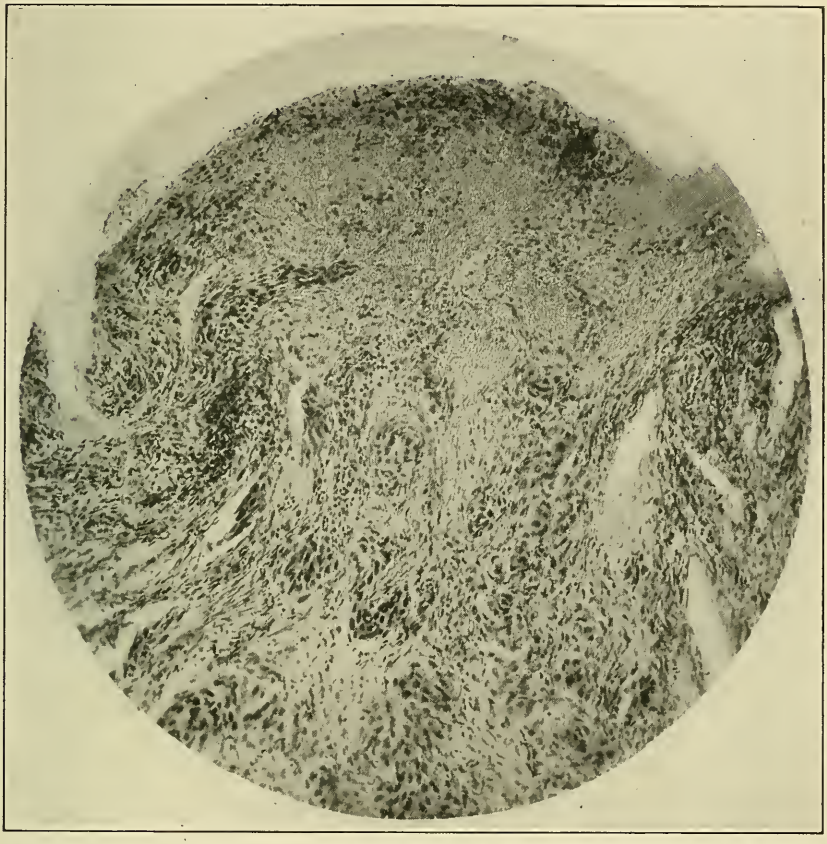


FIG. 108.—CARCINOMATOUS INFILTRATION BENEATH APPARENTLY NORMAL MUCOSA.

After suprapubic section even for simple papilloma relapse, as has been stated, has been extremely common—at least 50 per cent of the tumors returning. After fulguration relapses are far less common if we may judge from an experience of the last five years. With fulguration we may probably expect from five to ten per cent of relapses within the first two years. We have not followed the treatment long enough to know how rapidly this tendency to relapse diminishes.

TREATMENT

The treatment depends upon the diagnosis. If the patient's tumor is clearly a papilloma it should be treated by fulguration; if doubtful, it should still be treated by fulguration, but the progress of the cure checked by excision of portions of the tumor for pathological diagnosis, and by impartial study of the effect of the fulguration. If it is not satisfactory, suprapubic section should be resorted to at once.

If the tumor resists fulguration,[1] or if frankly carcinomatous (or if there are so many papillomata that it seems unwise to waste time over fulgurating them when a single operation would clear up the whole lot) fulguration is out of the question, and we have only to determine whether it is worth the patient's while to undergo a suprapubic section or not. Two classes of tumor certainly merit operation:

1. Multiple papillomata or papillary malignant growths that have not infiltrated the bladder wall. These should be exposed by suprapubic section, for destruction by cautery of the whole growth and its base.

2. Infiltrating growths are always operable if they are in the vault of the bladder, or in the fundus. Neoplasms involving the trigone and the ureter mouth may be removed with greater difficulty, the ureter being transplanted to some other portion of the bladder wall, but these tumors produce lymphatic metastasis so early that the hope of radical cure is small.

Such cases, perhaps, and the more advanced disseminated bladder carcinomata certainly, are candidates for radium treatment or total cystectomy. I have seen but one apparent cure of a desperate case by radium. The mortality of total cystectomy was prohibitive until Watson suggested dividing the operation into two parts, and making the preliminary ureterostomy or nephrostomy a separate operation; the mortality has thus been reduced to about 50 per cent. But although total cystectomy effectively and completely removes the primary tumor of the bladder, and dissection of the pelvic lymphatics, comparable to that performed by Wertheim for carcinoma of the uterus, may be done, the operation does not greatly commend itself. Its unpublished mortality is certainly far higher than that of statistics. The patient with ureteral or kidney fistulae is by no means in a comfortable or presentable state, no matter what apparatus he may wear, and, if the cystectomy has been performed for a tumor that really requires it, the prospect of metastatic recurrence is indeed forbiddingly great. I have three times performed cystectomy for the relief of symptoms, and the symptoms have been relieved—by a higher power than mine.

[1] Geraghty cured a previously obstinate case by renewed fulguration after apparently ineffectual exposure to radium.

NEOPLASMS OF THE URETHRA

Although any urethral neoplasm may occur in a virgin urethra, the neoplasms that occur in the male are found almost exclusively in patients who have had gonorrhea, and the papillomata are almost exclusively a feature of chronic gonorrheal urethritis.

The following varieties will be described:

Papilloma.
Angioma.
Fibroma.
Cysts.
Carcinoma.
Sarcoma.

Angioma and sarcoma are usually met with in the female urethra. The other varieties of tumor are found almost exclusively in the male.

Papilloma.—Papilloma of the urethra has quite the same characteristics as the so-called venereal wart that occurs upon the external genitals. In the anterior urethra they are fairly common about the meatus; but they have been observed deeper down the urethra, as far as the bulb. Modern posterior urethroscopy reveals minute papillomata in almost every chronically inflamed deep urethra (p. 203). They are usually multiple. They appear through the urethroscope as pointed, warty growths which bleed very readily. They usually disappear after a course of dilatation, or yield to the high frequency spark. Large masses of warts in the anterior urethra may be cured by inserting the urethroscopic tube up to the mass of tumors, so that they project almost into its lumen. A thick swab of cotton upon a probe is then introduced and violently rubbed to and fro, scraping off the papillary growths. The immediate hemorrhage is profuse, but is readily checked by pressure. The remaining fragments may be removed by fulguration.

Angioma.—Angioma of the female urethra, commonly spoken of as vascular polyp or *urethral caruncle,* appears close to the external meatus, usually on the floor of the urethra. The growth is common at middle life, though Geraldès (Mark [1]) has reported a case in a child three years of age. This tumor is exquisitely sensitive and causes agonizing pain on urination, which, combined with insistent infrequency of urination, may almost drive the patient insane. It may be cured by excision or by destruction with the cautery.

A few instances of similar growths have been reported in the navicular fossa of the male urethra.

Fibroma.—Fibromata are very rare and are usually mixed growths —fibromyxomata or fibromyomata. They occur singly, usually in the

[1] *Trans. Am. Urolog. Assoc.,* 1908, vol. ii.

bulb, but may involve the prostatic urethra. They are extremely rare in the female. Through the urethroscope they appear as smooth, minute tumors with a distinct pedicle.

Cysts.—Minute cysts of the urethral glands are sometimes seen in cases of chronic urethritis. Cyst of the prostatic utricle is a rare autopsy finding in infants. Cysts of the inflamed posterior urethra have no known clinical significance.

Carcinoma.—Though the *male* urethra may be invaded by carcinoma of the glans penis or of the prostate, primary urethral carcinoma is extremely rare. I have seen but three cases. Some 50 cases have been reported by Preiswerk and Mall (cf. Barney[1]). The tumor begins at or near the bulbous urethra. The symptoms are those of deep urethral stricture, resilient and indurated. The presence of carcinoma is not suspected until perineal section reveals the indurated character of the stricture.

The urethroscope distinguishes two types of tumor. One type is reddish and warty; the other white, presenting the aspects of a warty leukoplakia of the tongue. The striking characteristic of the growth is its hardness when the attempt is made to curette it. This characteristic establishes the diagnosis. In the few reported cases the only treatment attempted has been excision.

Mark states that of 21 microscopically confirmed cases all recurred within one year, excepting one of Oberlaender's, which had no recurrence twenty-one months after a resection, and Carcey's, which showed no recurrence ten months after a total emasculation.

Dr. Abbe is at present treating a case for me by applications of radium, and the tumor seems to be gradually disappearing.

Primary carcinoma of the *female* urethra may begin as a caruncle. It usually involves the vulva. Excision should include the vaginal glands. Whitehouse[2] has collected 44 cases.

Sarcoma.—Sarcoma[3] occurs usually in the female urethra. Eight cases of fibrosarcoma and one of melanosarcoma have been reported. They grow rapidly, and none of them has been cured.

[1] *Bost. Med. and Surg. Jour.*, 1907, clvii, 790. Cf. also *Zeitschr. f. Urol.*, 1913, vii, 30.

[2] *Proc. Royal Soc. Med.*, Jan., 1912.

[3] Cf. Mark, *Ann. Surgery*, 1912, lv, 416.

CHAPTER LIII

INJURIES TO THE KIDNEY AND URETER—ANEURYSM OF THE RENAL ARTERY

SUBPARIETAL INJURIES—RUPTURE

Subparietal injury of the kidney is rare. Among 13,455 autopsies there occurred 31 instances of ruptured kidney (Morris and Herzog[1]). Among 198 cases collected by Tuffier, 136 occurred in adult men, and in only 2 were both kidneys injured. Two hundred and eighty-one of Küster's 306 cases were males. Of 272 in which the particulars are stated, 142 occurred on the right and 118 on the left side, 12 being bilateral (Morris). In a series of 89 cases of contusion of the abdominal viscera the kidneys were injured 35 times (Makins[2]).

The kidneys may be contused by a variety of accidents, such as kicks, buffer accidents, falls, and even simple muscular effort. The lower ribs may be broken and driven into the organ, and many of the accidents are explicable only on the theory that the kidney is burst either by the impact of the ribs compressing it against the spine (Morris) or by increased intrarenal tension (Küster).

PATHOLOGY

Subcapsular Hemorrhage.—Morris relates two instances of extravasation of blood under the fibrous capsule of the kidney, caused by slight muscular exertion and producing severe pain. Calculus was suspected, but nephrotomy revealed only a subcapsular hematoma, the evacuation of which effected a cure. He believes that this form of rupture is not uncommon, and that the compression of the parenchyma, perhaps increased by repeated small hemorrhages, explains the irregular and protracted course of the symptoms in some cases, until ultimately the capsule gives way, the blood and disorganized parenchyma escape into the perirenal space, and this late hematoma demands operation which reveals a disorganized kidney.

Laceration of the Parenchyma.—The kidney substance may be lacerated in any direction and to any extent (Fig. 109). Portions of

[1] Morris, *op. cit.*

[2] Quoted by Watson and Cunningham.

the organ may be lopped off, or the whole kidney may be reduced to a pulp or torn away from its vessels and ureter. If the capsule and ureter remain intact the primary reaction is often slight; but usually both are torn, and as a result blood and urine are immediately poured into the perirenal space, at first distending it and forming a tumor in the loin, and later escaping from the orifice at the lower part of the perirenal fascia (or through any tear in it) to form a more or less generalized subperitoneal infiltration. This extravasation of blood and urine is more or less rapid in proportion to the extent of the rupture.

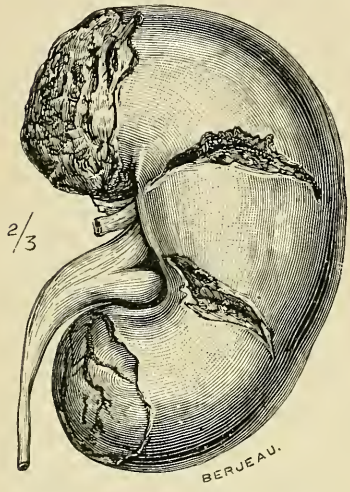


Fig. 109.—Ruptured Kidney.

The blood also pours down the ureter into the bladder and is expelled therefrom (hematuria).

Associated Lesions.—Laceration of the perirenal fat may occur alone or in connection with rupture of the kidney. It is unimportant. Fortunately laceration of the peritoneum is rare. In the adult there is a distinct layer of fat between the kidney and the peritoneum, which permits complete disintegration of the former without any injury to the latter; but in children this layer of fat is not developed, and, therefore, rupture of the peritoneum permitting rapidly fatal hemorrhage is relatively frequent in them but rare in the adult. It occurred in 12 per cent of Watson's cases. Rupture of the renal artery and vein is also rare. Rupture of the liver or spleen results in free hemorrhage which makes the renal lesion a secondary consideration. Fracture of the lower ribs and puncture of the diaphragm, the pleura, and the lung are among the associated lesions.

The Process of Repair.—Slight injuries of the renal parenchyma may heal promptly with but little associated inflammation,[1] and perirenal hematoma of some size may disappear within a few weeks by diffusion and absorption. Yet the usual outcome of rupture of the kidney—if the patient survives the immediate results of the injury—is infection of the urohematoma, suppuration throughout the wound, and gangrene of such portions of the organ as have been partially or completely torn away. The urinous, purulent collection burrows in various directions until the patient succumbs or the surgeon intervenes.

Other results are infarction, secondary hemorrhage, aneurysm of the renal artery, and traumatic hydronephrosis.

[1] Yarrow, *N. Y. Med. Jour.*, 1900, lxxi, 1.

Traumatic Hydronephrosis.—Traumatic hydronephrosis and pseudohydronephrosis are very rare results in trauma. True hydronephrosis has been reported only 17 times.[1] Pseudohydronephrosis is a urinous sac whose walls are made up partly of the renal pelvis, partly of cicatrized perirenal tissue.

SYMPTOMS

The symptoms of renal injury may be overshadowed by those due to rupture of other viscera.

Apart from the systemic *shock* and the local *pain* and *ecchymosis* due to the bruising of the abdominal wall, there are four cardinal symptoms of rupture of the kidney directly referable to the organ itself. These are hematuria, variations in the quantity of urine excreted, tumor, and pain.

Hematuria.—The passage of bloody urine after a contusion of the loin is the most characteristic symptom of ruptured kidney. Yet the hematuria may occur when the kidney is not ruptured,[2] and, on the contrary, there may be no hematuria, even though the kidney is ruptured. Thus the blood cannot reach the bladder if there is (1) subcapsular rupture, (2) occlusion of the ureter by clot, or (3) avulsion of the kidney from the ureter. Yet hematuria was a feature in 80 per cent of the cases collected by Watson.[3]

The course of the bleeding is very irregular. The blood usually flows freely for several days, and then ceases, either because the hemorrhage has stopped, or because the ureter becomes obstructed by clots. Blood cells and albumin may persist in the urine for many days, and recurrence of bleeding is not uncommon. Exceptionally there is no hematuria for the first few days. The blood passed is usually sufficient in quantity to dye the urine a deep red; yet, as a rule, the actual amount of blood thus lost is not alarming.

Variations in the Quantity of Urine.—During the first day after the injury there is oliguria, perhaps anuria, from shock. Continued anuria indicates rupture of both kidneys, or else incapacity of the opposite kidney (if there be one) to act, and is therefore an indication for immediate nephrotomy. But usually a polyuria replaces the primary oliguria, and lasts two or three days or longer. There may be reflex dysuria or retention.

[1] Wildbolz, *Zeitschr. f. Urol.*, 1910, iv, No. 4.

[2] Morris gives a long list of exceptional causes of hematuria after contusion of the loin, such as slight contusion of the kidney, renal congestion, thrombosis of the renal vessels, stone, malaria, villous tumor of the bladder. But the only feature of clinical importance is the persistence of bleeding. Uncontrollable bleeding, from whatever cause, demands operation.

[3] *Boston Med. and Surg. Jour.*, July 9, 16, 1903.

Tumor.—The extravasation of blood and urine about the kidney develops a tumor in the loin. This swelling may appear immediately, or its advent may be delayed several days, or no tumor may ever appear. The tumor is usually quite diffuse, filling the whole loin and perhaps extending even to the groin. The swelling is elastic, but fluctuation cannot be made out. General abdominal tension from the accumulation of flatus and from the tenderness of the bruised parietes may obscure a large perirenal hematoma.

Pain.—The pain of a ruptured kidney is an inconstant symptom. The superficial contusion produces local pain and tenderness; the passage of clots through the ureter may evoke renal colic, and the distention of the kidney, or its compression by effused blood, may produce an active pain radiating chiefly to the groin and testicle, and perhaps causing retraction of the latter.

COURSE OF THE DISEASE

1. The Injury Is Slight.—There is some shock, a temporary oliguria, and hematuria. After a few days the urine becomes quantitatively and qualitatively normal. No notable tumor appears in the loin, and the patient is well within ten days or so.

2. The injury is apparently slight, but the symptoms, instead of growing less, or perhaps after an apparent remission, become more severe. The lumbar tumor grows larger, pulse and temperature run high, the digestive functions are not properly established, the abdomen remains distended and tympanitic, there is constipation, anorexia, perhaps vomiting, the tongue is dry, the patient listless and irritable. This clinical picture indicates progressive urinary toxemia and sepsis, and calls for prompt drainage if the patient is to be saved. The presence of pleurisy, pneumothorax, or edema of the lung must not be overlooked.

3. The Injury Is Severe.—At first the patient is dazed, unconscious, or in a state of collapse. Hematuria and hematoma develop rapidly. He may fail rapidly and die of shock, of internal hemorrhage, of suppression, or, later, of septic complications. Or the hematoma may be gradually absorbed or become infected.

4. The Injuries Are Numerous.—In the most serious cases the renal rupture is only one among several visceral injuries. Rapidly fatal intraperitoneal hemorrhage may occur from the kidney, liver, or spleen. The triple infliction of shock, hemorrhage, and peritonitis can be combated only by immediate abdominal section with slight hope of success.

5. Septic Cases.—No case, however mild, is free from the danger of sepsis until the temperature has remained normal several days. Most large perirenal hematomas suppurate unless operated upon.

6. Traumatic Hydronephrosis.—Exceptionally the hematoma becomes encysted, forming the so-called traumatic or pseudohydronephrosis.

DIAGNOSIS

While slight injuries to the kidneys may be overlooked, especially if overshadowed by more important lesions of the other viscera, a kidney rupture of any great significance always manifests itself by loin tumor, usually associated with hematuria and oliguria or anuria.

The cystoscope and ureteral catheter complete the diagnosis.

TREATMENT

The treatment of shock is of the first importance. Opium must be sparingly employed for fear of masking the symptoms. The catheter should be employed with the most minute antiseptic precautions, for the bloody vesical pool is more than usually receptive of infection, and infection is—after the primary shock and hemorrhage have passed—the only noteworthy danger to the patient.

But all these measures are palliative at best. By them the symptoms are modified, but the essential features of the case—the hemorrhage, the function of the opposite kidney, the infection of the perirenal hematoma—are, to all intents, unaffected. Only by the knife can the surgeon reach these, and thus the momentous questions in the treatment of rupture of the kidney are, whether to operate and when to operate.

Immediate operation is required only when the patient fails to rally well from his shock. The possibility of intraperitoneal hemorrhage or rupture of some of the other viscera will lead the surgeon to fortify the patient by a large intravenous infusion, and then to operate, in the desperate hope of averting the fatal issue. Indeed my experience coincides with that of Michelson [1] who states that apart from laceration of the renal artery and vein, which may prove immediately fatal, the patients do not bleed to death. He reports 30 cases treated expectantly without a death from hemorrhage.

After the first shock is over expectant treatment may be continued on condition that the patient grows progressively stronger. Yet the surgeon must be ready to operate, and the patient and his friends prepared to submit, as soon as any unfavorable symptom manifests itself. The usual indication for operation at this juncture is continued hemorrhage, as evinced by the growing tumor in the loin, for "it is not the visible loss of blood by the bladder, but the easily overlooked but far more dangerous bleeding into the perinephritic tissues, or into the

[1] *Arch. f. klin. Chir.*, 1911, lxxxxvi, No. 3.

peritoneal cavity, that should receive the chief attention" (Keen[1]). Anuria persisting for twenty-four hours is an indication for immediate operation. Finally, beginning sepsis, suggested by an unfavorable temperature and pulse, must be cut short by operative drainage.

Although severe wounds in the kidney have been known to heal, the prospects of cases treated expectantly are not good. Thus, among 273 uncomplicated cases treated expectantly (Watson), 81 (30 per cent) died, and among 174 operated cases, 32 (18 per cent) died, while of the complicated cases treated expectantly, 31 out of 56 (60 per cent) died, and of the 59 complicated cases operated upon, 26 (44 per cent) died. I have operated upon 4 uncomplicated cases, with 1 death by ileus.

The Operation.—The surgeon employs the incision with which he is most familiar, as speed is all-important. The choice between the abdominal and the lumbar route depends upon whether any other visceral lesions are suspected. Though the abdominal route affords quicker control of the renal artery, the lumbar incision is habitually employed. Upon incision of the fascial envelope, clots, blood, bloody urine, or pus exudes, and should be quickly washed away. If copious bleeding is encountered, the renal artery must be clamped or tied immediately, though, as a general rule, the hemorrhage may be controlled by suture of the kidney and packing. The earlier operators performed nephrectomy for rupture of the kidney, as they did for every other surgical affection of the kidney, but this grave operation is rarely necessary. Generous drainage will allow for the expulsion of such detached fragments of kidney tissue as the surgeon overlooks. Secondary nephrectomy may be required if prolonged suppuration ensues.

WOUNDS OF THE KIDNEY

Wounds of the kidney (other than ruptures) are extremely rare. Even in military practice they are unusual. Of *incised and punctured wounds* (excluding bullet wounds) there are no instances recorded in the "Medical History of the War of the Rebellion." Küster[2] collected 43 cases. In 10 there were severe injuries to other organs, and of these 6 died (60 per cent), while among the 31 uncomplicated cases there were only 4 deaths (12.9 per cent). Keen records 8 cases with 2 deaths. Among Küster's cases 10 were operated upon (2 primary and 6 secondary nephrectomies), with no deaths; Keen records 4 nephrectomies without a death.

Morris sums up the diagnostic features of the condition as follows: "It may be stated (1) that a wound in the renal region succeeded by

[1] *Annals of Surgery*, 1896, xxiv, 138.

[2] *Deutsch. Klinik*, 1896, lii, 1, 221.

the escape of urine through the wound is conclusive of injury to the kidney; (2) that such a wound quickly succeeded by the discharge *per urethram* of urine heavily mixed with blood, or of pure blood, is almost conclusive, if not quite so; (3) that such a wound succeeded by retention of urine, or lumbar or abdominal pain and dysuria, even without hematuria, is highly suggestive of a superficial wound of the kidney, or of a deeper wound and the blockage of the ureter; (4) that hematuria succeeded by traumatic peritonitis is strong evidence of an injured kidney."

The chief clinical features of a penetrating wound of the kidney, other than the symptoms of rupture of that organ are: (1) External hemorrhage, (2) greater likelihood of infection from particles of clothing and dirt carried into the wound, (3) frequent involvement of the peritoneum and of the other abdominal viscera, (4) prolapse of the kidney, if the wound is extensive.

Treatment.—The treatment is much the same as that of rupture, except that exploration of the wound for the purpose of cleansing it, and exploratory abdominal section to insure the safety of the other viscera are more often necessary.

GUNSHOT WOUNDS

Although the recorded cases of gunshot wounds of the kidney show a very high mortality—viz., 59 deaths among 85 cases in the War of the Rebellion, and 8 deaths among 15 cases in the Franco-Prussian War—it is evident that this death rate is due to associated injuries. (Thus Edler[1] collected 20 uncomplicated cases with 5 deaths, and 18 complicated cases with 15 deaths.)

The only special features of these wounds are (1) the explosive effect of high-velocity projectiles—similar to that observed in the other semisolid viscera—(2) the advantage of employing the x-ray to locate the bullet.

ANEURYSM OF THE RENAL ARTERY

Morris has collected 19 instances of aneurysm of the renal artery, of which 12 were traumatic in origin.[2] He calls attention to this very rare condition because, apparently, it is always fatal (if of any size) unless the patient submits to operation. The aneurysm ruptures, causing a *spontaneous perirenal hematoma.*

The *symptoms* are tumor, pain, and hematuria. It is remarkable that pulsation is rarely detected. Morris detected a loud systolic bruit in his case, but no thrill. The *diagnosis* is made by operation.

[1] *Arch. f. klin. Chir.*, 1887, xxxiv, 379.

[2] Lippens (*Jour. de Chir.*, 1913, xi, 1) has collected 23 cases.

The *treatment* is operative. The aneurysmal sac should be disturbed as little as possible until the pedicle is secured. Albert, Hahn, and Keen have operated successfully; Morris unsuccessfully. A transperitoneal operation presents a better field for securing the renal vessels than does the lumbar route.

RUPTURE AND WOUNDS OF THE URETER

Rupture.—Subcutaneous rupture of the ureter is very rare. Morris [1] finds 24 reported cases, of which he rejects 12 and classifies the others as verified (3), probable (4), and possible (5). Macdonald, of Minneapolis, has added an authentic case.[2] The small size, loose attachments, and projected position of the ureter render it peculiarly likely to escape injury except from a penetrating wound.

It is quite impossible to distinguish rupture of the ureter from rupture of the renal pelvis except by operation.

Wounds.—Accidental wounds of the ureter are even more uncommon. Morris has found only 5 reported cases (2 bullet wounds), and quotes Otis's conjecture that these injuries do not come to the surgeon's notice because the trunk vessels are likely to be punctured.

Operative Wounds.—

The ureter is injured probably in from 1 to 3 per cent of all intraperitoneal operations upon the female pelvic organs. This accident is more common by the vaginal than by the abdominal route.

The causes of these injuries are: (1) displacement or intimate involvement of the ureter by pathological structures in the pelvis, especially uterine and ovarian tumors; (2) congenital abnormalities; and (3) lack of care by the operator.

The different kinds of ureteral injuries, stated approximately in the order of the frequency of their occurrence, are: (1) ligation, (2) clamping, (3) kinking (these three usually produce complete occlusion), (4) incision, (5) resection, and (6) destruction of blood supply. Complete obstruction may lead to the following results, named approximately in the order of their seriousness: Local—(*a*) infection—15 per cent, (*b*) fistula—24 per cent, (*c*) hydronephrosis—80 per cent, (*d*) general renal atrophy—less than 20 per cent in Barney's series. General—(*e*) toxemia—very rare, (*f*) anuria—1.6 per cent, (*g*) no symptoms—21 per cent. The mortality of unilateral ureteral obstruction is 18 per cent. (W. Jones.)[3]

Symptoms.—1. If the ureter is tied off or otherwise occluded the kidney, after going through a preliminary period of congestion and slight dilatation, atrophies without dilatation. In such a case, if the

[1] "Surg. Dis. of the Kidneys and Ureter," London, 1900, ii, 332.

[2] *Med. Record*, 1901.

[3] *Am. Jour. Obstet.*, 1914, lxx, 329.

opposite kidney is normal, the accident may never be recognized. On the other hand, even if both ureters are tied off, the complete anuria which results is symptomless up to the last moment, like calculous anuria.

2. If the ureter is divided and the accident passes unrecognized, the position of the wound is usually such that the urine discharges into the vagina and a uterovaginal fistula remains to be dealt with.

3. If the wound is so situated that the urine is extravasated within the peritoneal cavity, it sets up peritonitis, immediate and general if the urine is bacterial, remote and localized if the urine is clean. The source of the infection is suspected only when urine is discovered in the discharge.

Treatment.—In the early days of pelvic surgery nephrectomy was the only alternative offered to those women who were left with ureterovaginal fistulae after hysterectomy. But in 1886 Schopf, Fritsch, and Tauffer (twice) each recognized at the time of operation that he had divided the ureter and proceeded to sew the ends together. Thus began the conservative surgery of the ureter, and thus from the mishaps of gynecology has arisen the most brilliant conservative achievement of urinary surgery, the preservation of the healthy kidney whose duct has been severed.

The modern treatment consists of ureteral anastomosis, or, if that is impossible, nephrostomy if the condition of the opposite kidney is indetermined; nephrectomy if it is known to be adequate.

CHAPTER LIV

WOUNDS AND RUPTURES OF THE BLADDER AND URETHRA

WOUNDS OF THE BLADDER

Wounds of the bladder are not common, since the position of the organ protects it from ordinary accidents, inclosed as it is, when in a state of relaxation, by the bony pelvis. Excepting the violence done by cystoscopes, lithotrites, or during other operations, the bladder is but little liable to injury except when overdistended. Rising above the symphysis pubis it becomes exposed to incised, punctured, and gunshot wounds. Wounds of the bladder are exceedingly dangerous to life without being necessarily fatal. Bullets and fragments of shell have entered the bladder without producing fatal consequences,[1] and there formed nuclei for calculus, as have also portions of bone. Surgical wounds aside, Bartels [2] was unable to find among 405 reported wounds of the bladder any incised wound. Lacerations of the bladder not communicating with the external wound are, clinically, ruptures.

Symptoms and Prognosis.—The symptoms of wounds of the bladder are comparable to those of rupture (plus an external wound). The *prognosis* depends upon the presence and severity of the complications, the availability of surgical assistance, and the position of the rupture, whether it is intraperitoneal or extraperitoneal. Bartels collected 131 cases of intraperitoneal wounds, of which only 1 survived, while of 373 extraperitoneal wounds only 85 died. These statistics belong to the preantiseptic period.

Evans and Fowler [3] have collected 25 cases reported since 1877, of which 7 were intraperitoneal injuries with 2 deaths, and 18 extraperitoneal with 2 deaths.

Treatment.—The treatment is immediate incision, suture of the bladder, and packing of the external wound to prevent infection and secondary infiltration. If the case is not seen until infiltration has set in, wide incisions, irrigation, and drainage are necessary.

[1] I have recorded in the *New York Journal of Medicine*, May, 1865, the case of an adult whose bladder was perforated by a bullet during the New York riots in July, 1863, terminating in complete recovery.—Van Buren.

[2] *Arch. f. klin. Chir.*, 1877, xxii, 519, 715.

[3] *Ann. Surg.*, 1905, xlii, 215.

RUPTURE OF THE BLADDER

A bladder, when overdistended by urine, may be ruptured by external violence, and this especially if it be atrophied or thinned by disease, ulceration, or otherwise; or the accident may occasionally happen by the accumulation of urine alone without any recognizable external violence, as in case of stricture. Such a spontaneous rupture is undoubtedly attributable to muscular contraction.

Among the exciting traumatic causes, falls, blows, and crushing injuries, with or without fracture of the pelvis, or even appreciable injury to the soft parts, may be mentioned. The patient is usually intoxicated at the time of injury, the alcohol predisposing him to rupture of the bladder in a threefold way—viz., by causing the bladder to fill rapidly, by obtunding its sensibility, and by facilitating the injury. Intraperitoneal rupture without known trauma has been several times reported. I have seen such a case; the patient was entirely sober.

Subperitoneal rupture, in which the fundus of the bladder is torn without lacerating the peritoneum, need not be distinguished, for it either remains extraperitoneal or becomes intraperitoneal.

Intraperitoneal rupture is the more frequent variety. It is caused by a blow upon the hypogastrium bursting the distended organ as a blow bursts a paper bag. There are often no associated lesions. It has been surmised that the fundus yields to the distending force not through any weakness of the bladder at that point, but because the intestines give way before it, while below the bladder is supported by the bony pelvis.

Extraperitoneal rupture is almost always associated with fracture of the pelvis.

Mitchell[1] has collected 90 cases, of which 36 per cent occurred on the anterior surface, and most of the others about the neck. Rupture of the sides or base is commonly intraperitoneal.

Rupture of the empty bladder is extremely rare, always extraperitoneal, and due to fracture of the pelvis.

Rupture of the bladder from overdistention preliminary to cystotomy has been reported 10 times.[2] This accident is always avoided if the bladder is distended *after* incision of the parietes.

Results.—Peritonitis is the almost inevitable outcome of intraperitoneal rupture. As a rule, the urine is infected and the peritonitis immediate. But if the urine is aseptic this peritonitis may be delayed several days; may even fail to appear altogether if the amount of urine extravasated be small.

[1] *Ann. Surg.*, 1898, xxvii, 151.

[2] Horwitz, *Ann. Surg.*, December, 1905.

Extraperitoneal rupture results in cellulitis and suppuration about the bladder. Peritonitis may result as a secondary complication.

Complications.—Fracture of the pelvis can scarcely be termed a complication of rupture of the bladder. The bladder lesion is the complication, since it results from the disintegration of the pelvic ring. In such cases the bladder rupture is usually extraperitoneal.

Rupture of the membranous urethra is sometimes associated with rupture of the bladder as a complication of pelvic fracture.

Symptoms.—All the symptoms of rupture of the bladder may be absent in a given case, or obscured by symptoms due to other injuries.

The symptoms of a classical case have been well summarized by Besley,[1] as follows:

1. At the time of the injury there is immediate severe pain in the abdomen, and sometimes a distinct sense of something tearing or giving way. This is described by the patient as being in the lower part of the abdomen, or occasionally referred to the region of the heart. The severe pain felt at the outset is usually continuous. Marked symptoms and signs of collapse are quite constantly found. . . .

2. The patient is unable to walk, or walks with great difficulty. Records of cases show this to be an almost constant condition.

3. One of the most prominent and constantly present symptoms is the strong desire, accompanied with an inability, to void urine. A few drops of blood or bloody urine usually pass from the urethra. Not infrequently, however, the patients are able to void urine in either an extraperitoneal or an intraperitoneal rupture. Bloody urine was a marked sign in every case of this report.

4. The subsequent course of the disease and the symptoms depend upon the location of the rupture and the direction of the extravasation.

If the tear is intraperitoneal, the course will be that of a peritonitis with obstipation, vomiting, and high pulse and temperature. It must be borne in mind that the temperature curve is only one item, and the presence or absence of fever is not absolutely diagnostic for or against a peritonitis.

When the rupture is extraperitoneal, the symptoms are those due to an extravasation of the urine into the tissues, giving rise to the absorption of the poisonous properties of the urine and the toxins of the accompanying suppuration.

These symptoms are those of sepsis, with chills, high pulse, irregular temperature curve, headache, and gastro-intestinal disturbances.

Diagnosis.—Rupture of the bladder may be suspected when a patient has received a contusion of the hypogastrium or a fracture of the pelvis and thereafter either passes bloody urine or no urine at all; when a patient in alcoholic stupor shows undue rigidity and tenderness about the hypogastrium and catheterism draws no urine or bloody urine; when a patient known to suffer from a grave bladder lesion complains of sudden severe hypogastric pain and thereafter strives in vain to urinate; and when there is fracture of the pelvis.

[1] *Surgery, Gyn., and Obstet.*, 1907, iv, 514.

The diagnosis is verified by a study of the symptoms aided by palpation, urethral instrumentation, and, if necessary, by exploratory operation.

Palpation.—At the outset, palpation of the hypogastrium reveals rigidity and tenderness (which may, however, be due to parietal contusion). Later the space of Retzius may be filled by a doughy sensitive infiltrate (extraperitoneal rupture) or the rigidity and tenderness may extend to the whole abdomen (intraperitoneal rupture).

If the rupture is extraperitoneal rectal palpation may reveal tenderness and infiltration.

Catheterism.—The catheter usually withdraws a little bloody urine. Exceptionally a large amount of urine is obtained that shows blood only to the miscroscope.

If catheterism is impossible because of ruptured urethra, immediate perineal section should be performed.

Injection Tests.—Injection of air may increase the shock, and is therefore condemned.

Injection of a measured quantity of salt solution, to see whether it all returns, may be employed in doubtful subacute cases; but this test is far from infallible. If the rupture is small or valvelike all the fluid may return.

Moreover, the surgeon should be prepared to follow up the examination by immediate operation if rupture is discovered, since this instrumentation is calculated to spread urine and infection broadcast throughout the peritoneum or the cellular tissues.

Hence, recent writers follow Alexander [1] in condemning this test.

If the diagnosis is obscure it may be verified by cystoscopy. I was thus able to diagnose a bullet wound of the bladder.

Exploratory Operation.—If there is still doubt, the abdomen should be opened in the median line, and the peritoneum opened. Palpation then detects any infiltration about the base of the bladder.

Treatment.—When the diagnosis is established there is no treatment other than immediate operation; when it is in doubt an exploratory operation affords the quickest and surest means of reaching a conclusion that must be reached quickly if at all. The only contraindications to operation are shock and grave visceral injuries, and if an infusion of salt solution improves the general condition the operation should be performed even in shock.

The first incision should open the peritoneal cavity through the median line. If an intraperitoneal tear is encountered, it is closed with a layer of Lembert sutures in the bladder wall, and another in the peritoneum. All accumulations of fluid are gently mopped up. Meanwhile the strength of the suture line is tested by filling the bladder

[1] *Ann. Surg.*, 1901, xxxiv, 209.

with salt solution. If any escapes, the leaky portion of the wound is protected by additional sutures. This test is most essential. In 4 cases mentioned by Walsham [1] the cause of death was leakage through the sutured bladder wound. The abdominal wound is then closed with a single wick of gauze running to the point of rupture.

If the peritoneum proves to be untorn, the abdominal wound is closed and the bladder opened through a small suprapubic incision. If the hole in the bladder is found presenting, it is sutured, tested, and the external wound drained. But if the rupture is situated at the bladder neck or at some other inaccessible point, it may be treated by suture or left untouched, and drainage may be established through the abdominal wall and the urethra or the perineum.

Prognosis.—Among Mitchell's 90 cases of extraperitoneal rupture of the bladder 37 were operated upon and 24 of these died (64.9 per cent); while of the 53 treated expectantly 51 died (96.2 per cent). Sieur [2] collected 34 cases of intraperitoneal rupture, all operated upon, with the following results:

Operation.	Cases.	Cured.	Died.	Mortality.
Within 12 hours	13	8	5	38.4 per cent.
12 to 24 hours	10	3	7	70 "
24 to 62 hours	11	3	8	72.7 "
Total	34	14	20	58.8 "

Without operation practically all would have died.

These statistics encourage early operation so markedly as to call for no comment. Doubtless the relatively low postoperative mortality of intraperitoneal (58.5 per cent),[3] as compared to extraperitoneal rupture (64.9 per cent), may be due to the fact that the immediate gravity of the peritoneal cases enforces early operation, while the slower progress of extraperitoneal ruptures encourage ill-advised delay.

WOUNDS OF THE URETHRA

The urethra may be wounded by traumatism from within or from without. External wounds only concern us here. Internal wounds, whether produced by foreign bodies, by instrumentation, or by internal urethrotomy, find more appropriate exposition under their respective titles.

[1] *Univ. Med. Jour.*, 1895, iii, 200.

[2] *Archiv gen. de méd.*, 1894, i, 129.

[3] Alexander gives 51.1 per cent, Watson, 42.2 per cent.

Punctured Wounds.—The prognosis of a punctured wound of the urethra is generally good. For simple punctured wounds a single irrigation of the wound and the urethra with an antiseptic solution (e. g., permanganate of potassium, 1:4,000), followed by careful catheterization for each urinary act during the first one to three days, should result in a cure. If the puncture is merely the central point of a laceration or a contusion of the canal, the treatment must be carried out as laid down for these conditions. Complicating suppuration, infiltration, or fistula requires appropriate treatment, as indicated below.

Incised Wounds.—Clean-cut wounds are very rare in the perineum; they usually implicate the penile urethra, the corpus spongiosum, and often some portion of the corpora cavernosa. The *complications* to be feared are periurethritis, traumatic stricture, and fistula. Wounds in the scrotal region are most likely to be followed by severe inflammation, while obstinate fistula is the usual complication of wounds of the penile urethra. The prognosis of stricture, on the other hand, depends on the extent rather than on the situation of the lesion. Stricture does not follow longitudinal wounds of the urethra, but results rapidly from any transverse or oblique wound. When the anterior urethra is completely severed, the cut ends retract within the corpus spongiosum to such an extent that it may be difficult to bring them together again.

Treatment.—Immediate suture with suprapubic drainage as for rupture.

RUPTURE OF THE URETHRA

This includes all contused and lacerated wounds of the canal inflicted from without, and is by far the most common urethral injury, the lesion usually involving the bulb, rarely the pendulous, and still more rarely the posterior urethra.

Etiology.—1. *The pendulous urethra* is practically safe from injury except during erection; but in that condition it is liable not only to extensive injury, as in fracture of the penis and breaking a chordee, but also, as Guyon insists, to slight tears by bruising during coitus—injuries which, though scarcely noted at the time, may have dire consequences.

2. *Rupture of the bulb* is usually the result of direct violence—falling astride of a beam or some such hard object (in 82 per cent—Kaufmann), a kick upon the perineum, or the jolting of a rider onto the pommel of his saddle.

3. *The posterior urethra* is torn only with fracture, dislocation, or severe strain of the pelvis, or, exceptionally, by excessive direct violence. The membranous urethra is commonly involved, being torn with the triangular ligament, while the prostatic urethra is spared in all but the most extensive fractures.

The *mechanism* of rupture of the bulb has provoked much dispute. When the force is applied obliquely, the canal is crushed against the ischiopubic rami; when from in front, as, for instance, in a fall with the body bent forward, the impact is against the front of the pubes (Oberst, Terrillon); while in certain cases, where the force is applied directly from below, the urethra is probably torn at the sharp edge of the suprapubic ligament (Ollier and Poncet). It is upon this last theory that differences of opinion persist.

Pathology.—The trauma which ruptures the urethra generally spares the surrounding soft parts. As the injury is usually the work of a blunt implement, the skin and the muscles are not torn, and the superficial aspect is, frequently enough, that of a mere bruise or abrasion.

The canal itself may be merely bruised, or more or less completely torn asunder. In the posterior urethra complete laceration is the rule, the canal being broken, as it were, in the grip of the triangular ligament. In the bulb complete laceration through part of the circumference of the canal is the rule; but the roof is usually spared—a point of considerable importance in subsequent catheterization. In the anterior urethra the milder injuries consist in mere interstitial hemorrhage [1]—contusions, as it were—of the corpus spongiosum, with perhaps slight lacerations of the mucous membrane or of the sheath of the spongy body.

Symptoms.—The cardinal symptoms of injury to the urethra are pain, tenderness, bleeding, interference with urination, and tumefaction.

The *pain* is sharp and occurs at the moment of rupture. It may be the only symptom of interstitial rupture due to a jar to the erect penis. As it abates rapidly the patient may pay but little attention to it, though even a slight injury may lay the foundation for traumatic stricture. The pain recurs with each act of urination for a longer or shorter time, according to the gravity of the injury and the temperament of the person.

Tenderness exists primarily at the point of injury and later in the course of inflammation.

Bleeding from the meatus is a constant symptom. It is lacking only in the rare cases in which the mucous membrane is uninjured. It occurs quite independent of urination (urethrorrhagia), its quantity not indicating the severity of the lesion. The unbroken skin usually prevents external hemorrhage, though a hematoma of some size is not unusual.

[1] The possibility of this condition, as well as its clinical importance, has been warmly debated. Baron (*Presse méd.*, 1898, i, 250) sums up the evidence at hand, and shows that a simple contusion, without any break in the mucous membrane, may perfectly well be the starting-point for traumatic stricture.

Hematuria combined with urethrorrhagia indicates an injury to the posterior urethra.

The *disturbance of urination* varies from the hesitancy excited by the pain of the milder cases to complete retention. This latter, indeed, is the usual condition, and is due to contraction of the lacerated urethra and to spasm of the cut-off muscle, rarely to hematoma of the corpus spongiosum. The retention, if not speedily relieved, is intensified by the congestion and inflammation about the wound.

Tumefaction, primarily the effect of hemorrhage, secondarily of urinary infiltration and suppuration, follows the fascial spaces. The tumor after injury to the pendulous urethra is usually a circumscribed one within the corpus spongiosum, but may follow the course of a perineal infiltration and extend throughout the scrotum and penis. Effusions within the triangular ligament are retained there to form a tense perineal tumor, which may burst either forward or backward, while injury to the prostatic urethra leads to infiltration of the rectovesical space.

Diagnosis.—The diagnosis of the extent of injury is not easy. Immediate interference with urination, which always follows complete rupture, may be caused by spasm or by retained clots. Catheterization, impossible if there is complete rupture, may fail even in milder cases. It is sufficient, however, for practical purposes, to diagnose the severity of the case according to the symptoms, as indicated below. Diagnosis of the position of the injury may be made with a fair degree of accuracy from its etiology and the location of the tenderness and tumor. The presence of urethrorrhagia, while establishing the existence of rupture of the urethra, does not exclude rupture of the bladder; but a positive diagnosis of the latter condition is usually practicable.

Course and Prognosis.—Guyon's classification is convenient as offering the most precise indications for treatment. It is as follows:

1. *Mild injuries to the pendulous urethra,* in which the trauma is succeeded by a sharp pain, slight bleeding, and a few painful urinary acts, are not likely to be followed by any serious consequences, except traumatic stricture, which is almost inevitable.

2. *Moderately severe injuries to the pendulous urethra* are characterized by free bleeding, painful and impeded urination, and a hematoma of some size. The chief danger here lies in infiltration and periurethral suppuration and later traumatic stricture.

3. In the *severe injuries* and in most *perineal cases* complete retention is the prominent symptom. It can rarely be relieved otherwise than by external urethrotomy.

In any case traumatic stricture may be predicted—a condition formidable both in its rapidity of onset and its rebelliousness to treatment (See Chapter XXVII).

The mortality from rupture of the urethra is low. Terrillon records

12 deaths in 170 cases, chiefly from uremia, septicemia, and hemorrhage.

Treatment.—1. For *mild injuries to the pendulous urethra* expectant treatment should be employed. Rest in bed, free purgation, and the internal administration of hexamethylenamin should be supplemented by injection twice a day of 3 to 5 c.c. of silver nitrate solution (1: 2,000) or protargol (1: 1,000) into the anterior urethra. Catheterization is unnecessary and absolutely contra-indicated. Extravasation or suppuration must be met by prompt incision. Three days after the symptoms have subsided the patient may be pronounced free from all dangers except stricture, against which he must be warned, and for which treatment is to be instituted on its appearance. The contraction usually begins within six weeks of the time of injury.

2. *Moderately severe anterior injuries* represent, in a general way, slight lacerations, in which one may hope to avoid infiltration by keeping the urethra cleansed, as above, and preventing any contact of the urine with the wound. A small (15 French) rubber catheter should be tied in.

3. *Perineal ruptures* and all *severe injuries to the pendulous urethra* call for immediate external urethrotomy and suture. Palliative measures, such as suprapubic aspiration, catheterization, or the retained catheter, cannot save the day. Aspiration may be useful to relieve the distention of the bladder and thus to gain time, but the retained catheter is worse than useless. It serves only to invite infiltration, while repeated catheterization is impossible as soon as congestion sets in. On the other hand, perineal section relieves the retention at once, while suture of the divided ends of the urethra affords the surest means of preventing resilient traumatic stricture.

Marion[1] very properly insists upon the great advantage of deflecting the urinary stream through a suprapubic fistula. He performs this first, does retrograde catheterization if necessary and sutures the urethra about a catheter. The perineal wound is left open. He reports 10 cases with no subsequent stricture.

URETHRORECTAL FISTULAE

Urethrorectal fistulae are very rare. They commonly arise from the prostatic urethra. They are caused by trauma (usually surgical), abscess of the prostate, tuberculosis, or malignant disease. Tuberculous and cancerous fistulae are quite incurable and need not concern us. Traumatic and inflammatory fistulae, on the other hand, commonly recover. I once opened a prostatic abscess into the rectum only to

[1] *Jour. d'Urol.*, 1914, v, 553.

find that it had just burst into the bladder. The resultant fistula healed in four weeks. I have thrice opened the rectum during prostatectomy. Each time the fistula healed spontaneously. But the fistula that does not heal in three months will never heal spontaneously.

Treatment.—Cases that do not recover spontaneously require operative interference unless they are so slight that they cause the patient no material discomfort. The healing of these fistulae is an exceedingly difficult task. One can not guarantee that the operation will not leave the patient in a worse condition than before.

CHAPTER LV

MALFORMATIONS OF THE KIDNEY AND URETER

The malformations of the kidney and the ureter are explicable in terms of the embryological development and migrations of these organs. Charles Mayo [1] has summed up the essentials of the embryology of the kidney in so far as it bears upon the malformations of the kidney and the ureter as follows:

The kidney-secreting substance extends as mesothelial bodies or nephrogenic tissue from the lower dorsal to the second sacral vertebra. They lie close together with the aorta between. This substance is supplied by many blood-vessels derived from a delicate plexus surrounding and connecting with the aorta. From a pouch which early appears from the lower portion of the wolffian duct are developed the ureter and pelvis of the kidney. This collecting portion becomes attached to the secreting portion by climbing up the ladder of the blood supply, so to speak, of the nephrogenic substance. The numerous blood vessels drop off and enlarge as the pelvis of the kidney ascends to its higher position, and the secreting substance arranges itself over it and forms a capsule. The two mesothelial bodies may touch each other and become fused, developing the horseshoe kidney or various attachments; 90 per cent of the horseshoe kidneys being fused at the lower pole. Some of the mesothelial or secreting portion of the kidney may not become connected with the collecting portion and may then retain its embryonic type, forming a mesothelial rest from which may develop so-called "hypernephroma" or, more correctly, mesothelioma of the kidney (Wilson). In other cases a failure of connection between the secreting portion with the collecting cavity and continuance of secretion without elimination form a congenital cystic kidney, usually double.

Wherever the kidney stops in the process of union of collecting and secreting portions, its renal artery develops from the major supplying it at the time. As growth continues, the delicate vascular plexus outside the aorta disappears and the renal artery comes directly from the aorta; but owing to change in position it may come from a lower position on the aorta, the sacral artery or from the common iliac. The malposition of the kidney is not so serious if it can but carry on its function, but malposition may lead to injury. Excessive mobility is not a disease unless the renal function is interfered with or the kidney in its movements disturbs some other organ; thus the movable right kidney may disturb a diseased appendix, the appendix, however, being the primary offender. Mobility may interfere with urinary delivery by kinking the ureter over a band of connective tissue or an anomalous artery which occasionally is seen connecting the lower pole of the kidney with the aorta, one of the original mesothelial vessels which failed to disappear. One kidney

[1] *Surg., Gyn. & Obstet.*, 1916, xxii, 16.

may be missing from a failure of development of the mesothelium—the secreting structure. Three or four kidneys may be present with three or four complete ureters or partial ureters. Splitting the collecting portion at the wolffian duct causes double ureters and fused or separated double kidneys on one or both sides. The division of the pelvis into several tubes connecting with one or two ureters is normal in the otter and beaver.

MALFORMATION OF THE KIDNEY

Frequency.—Abnormalities of the kidney are very rare. Morris[1] has collected the records of 11,168 post mortem examinations at the Middlesex Hospital and Guy's. Excluding movable kidneys, 16 cases of double ureter, and 53 cases of acquired atrophy and small cirrhotic kidney, his cases may be tabulated thus:

Congenital atrophy (unilateral)	11 cases.
Fused kidney	1 case.
Horseshoe kidney	16 cases.
Lobulated kidney (4 bilateral)	9 cases.
Malformed kidney (1 bilateral)	6 cases.
Misplaced kidney	10 cases.

About 1 case in 211.

Motzfeldt[2] found 79 cases of deformity of some kind at 4,500 necropsies, including 9 of horseshoe kidney; double ureters in 23; hydronephrosis in 21; aplasia in 10, and hypoplasia in 11—a total of deformities of some kind in the urinary apparatus in 2 per cent of all the cadavers. One of the kidneys was abnormally small in 22 cases; the other was hypertrophied in a few instances.

CONGENITAL MALFORMATIONS

Malformation Without Fusion.—Most of the malformations without fusion are unimportant. *Fetal lobulation* may persist in part or in the whole of a kidney throughout life. *Simple hypertrophy* of a kidney is usually compensatory to the atrophy of its fellow. Neither of these present any surgical interest excepting that the latter may be mistaken for tumor. The misplaced kidney may be deformed by the pressure of the surrounding viscera. Movable kidneys may assume very curious shapes. Considerable malformation of the kidney is usually associated with misplacement and is of interest in that connection.

Congenital Atrophy.—Extreme atrophy of the kidney of congenital

[1] "Surgical Diseases of the Kidney and Ureter," 1901, i, 32.

[2] *Norsk. Mag. f. Laeg.*, 1914, lxxv, No. 7.

origin is extremely rare. Geraghty and Plaggemeyer[1] find that the estimates vary from 1 in 110 to 1 in 3,993 cases. The disagreement is due to the variation in what the observer is willing to accept as an atrophied kidney. Partial congenital atrophy or smallness of a kidney is not infrequent. I have encountered it three times in operating upon 186 kidneys. The condition is of the utmost surgical importance because the small kidney may be entirely normal and yet not possess

Fig. 110.—Congenital Kidney Atrophy; Stone in Pelvis; Pyelitis Cystica.

sufficient kidney tissue to support life, while its fellow may be diseased and require nephrectomy. Unless care is taken in the ureter catheter diagnosis the fact that the healthy kidney is putting out but a small quantity of urine may be overlooked. Geraghty called attention to this fact and gave a formula for the recognition of the condition (which, of course, applies to acquired as well as congenital atrophy). Their formula, as applied to the healthy kidney, is the following:

The *amount* of urine excreted is small. Therefore, though the *percentage* of urea is normal, the *total urea* is diminished. The *phenolsulphonephthalein output* is also diminished. By the use of this formula, I was able to diagnose atrophy in the kidney shown in Fig. 110.

[1] *Trans. Am. Assn. G.-U. Surg.*, 1913, viii, 48.

The x-ray had previously shown the stone; the cystoscope revealed a very small middle lobe of the prostate; ureter catheters were readily introduced on both sides, and there was no extra-catheter flow. The urine from the right kidney showed a few pus cells, 1.2 per cent urea, phenolsulphonephthalein 7 per cent in 2 c.c. (after a delay of 10 minutes in its appearance). The left kidney gave no pus, urea 1.3 per cent, 25 per cent phenolsulphonephthalein in 8 c.c.

Anomalies of the Blood Vessels.—Rupert[1] in a recent review of this subject, chiefly founded on a personal study of 118 cadavers, found among the 236 kidneys examined 77 arterial and 26 venous abnormalities. Fortunately, however, the surgeon does not require to make an intimate study of these variations, but simply must know that they are extremely common. In the normal kidney the main artery and vein may be double, and may not arise directly from the trunk vessels. Moreover, accessory arteries and veins may run to the upper or lower poles. The careful surgeon will, therefore, always palpate any bundle of rather thick tissue or adherent substance at either pole of the kidney before cutting this. If the pulsation of an artery is felt in it this will be spared if possible, for the renal arteries are, to all intents and purposes, terminal. If no pulsation is felt the band of tissue will be separated gently, and if a vein is found or accidentally torn this will simply be ligated, for venous anastomoses within the kidney are plentiful.

Animal experimentation would seem to suggest that the renal arteries are not strictly terminal, but are provided with anastomosing capillaries so extremely small that they escape injection by the ordinary methods (Liek[2]).

The displaced or malformed kidney usually has a number of irregular arteries and veins arising, as suggested above, from adjacent portions of the great vessels.

The Misplaced Kidney.—The misplaced, dystopic or pelvic kidney is totally different from the movable kidney. The latter has reached its normal position at the loin, but has a long pedicle and a certain degree of mobility within the loin. The misplaced kidney has never reached its normal position, and is fixed in an abnormal one.

The following data are derived chiefly from the contribution of Plummer:[3]

Whereas the movable kidney is usually on the right side, the misplaced kidney is usually on the left side. The misplaced kidney may be found either within the small pelvis or in the region of the promontory of the sacrum. The majority of misplaced kidneys are not single kid-

[1] *Surg., Gyn. & Obstet.*, 1915, xxi, 471.
[2] *Arch. f. klin. Chir.*, 1915, cvi, 435.
[3] *Surg., Gyn.* & *Obstet.*, 1913, xvi, 1.

neys but the majority of single or fused kidneys are misplaced. Of Strater's cases, 12 were hydronephrotic, 6 pyonephrotic. He also noted stone, sarcoma, tuberculosis and cystic disease.

Many misplaced kidneys function perfectly well during life, and are found at autopsy. They may themselves become diseased, in which case they give the symptoms of the disease with which they are afflicted, but the most frequent way in which they arouse surgical interest is by their interference with pregnancy. The pregnant uterus, pressing upon the misplaced kidney, is very likely to cause acute retention or infection, or, on the other hand, if the kidney is sufficiently diseased to become a large mass, it may actually impede the progress of pregnancy. It is alleged that a feeling of weight and pain in the lower abdomen, dyspareunia and disturbances of the function of the bladder and rectum may result from the misplaced kidney. Misplacement of the kidney will be suspected whenever pregnancy is interfered with by an obscure abdominal growth, or when the symptoms of some renal disease are associated with a mass in the lower portion of the belly. The condition can be satisfactorily diagnosed only by pyelography as has been beautifully illustrated by Braasch.[1] D. Bissell [2] has been able by careful dissection in three cases to replace the misplaced kidney sufficiently high in the loin to insure the three essentials: freedom from pressure, good ureteral drainage, and good vascular supply. The operations were performed by freeing adhesions, and severing the smaller vessels, both arteries and veins, notably those going to the lower pole. Strater suggests that this is the proper treatment at the beginning of pregnancy, but that in the last few months premature labor should be induced, and nephrectomy or replacement performed later. Cesarean section may be necessary. Cragin made a vaginal puncture of a hydronephrotic kidney. Fifteen hours later the patient went through a normal labor.

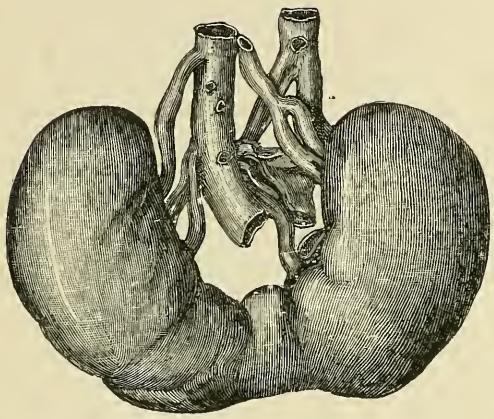


Fig. 111.—Horseshoe Kidney.

The Fused and Horseshoe Kidney.—The single kidney results from atrophy of, or absence of, its fellow whose ureter is either entirely absent or only partially developed. Fusion of the kidney results from actual union of the two kidneys with two or more ureters draining the

[1] "Pyelography," 1914. [2] *Trans. Am. Gyn. Soc.*, 1911.

combined mass. The commonest form of fusion is the *horseshoe kidney.* The two kidneys lie usually a little lower than their normal position with their lower poles bound together either by a band of fibrous tissue, or by an isthmus of actual renal tissue. This isthmus in 9 cases out of 10 lies in front of the great vessels. The ureters usually pass down in front of the isthmus. (Fusion of the upper pole is extremely rare.) Thirty cases were found in 21,218 autopsies (1 in 707 collected by Morris Preinelsverger and Socin).[1] Rovsing[2] records as extreme statistics the reports of Kraft and Scheel, who found 12 cases in 9,142 autopsies (1 in 500), and Fibiger, who found but 1 horseshoe kidney among 2,294 autopsies. I have encountered the condition twice in less than 200 operations for renal disease. The "S" or *sigmoid kidney* is a form of renal fusion in which one kidney lies below the other, each organ being somewhat misshapen; and the upper pole of one being fused to the lower pole of the other. The remaining rare conditions may be classified as the "misshapen kidney." Such kidneys are often misplaced, and usually in the middle line near the promontory of the sacrum.

Rovsing, as a result of an examination of 4 cases, has constructed a clinical picture of horseshoe kidney consisting of a pain across the abdomen induced by exertion, exaggerated when the patient bends over backward, and relieved by lying down. The tumor, he says, can be palpated in front of the great vessels. I suspected horseshoe kidney in one of my cases because of early bilateral tuberculosis. Careful examination failed to reveal any of these symptoms, but operation showed a horseshoe kidney. The condition is usually diagnosed during operation by finding the ureter in front of the lower pole of the kidney, and later identifying the connecting band. If one may judge from two cases, operations upon the horseshoe kidney present no very unusual difficulties. In the case mentioned above, half of the tuberculous horseshoe kidney was successfully removed.

Supernumerary Kidney.—The presence of rudimentary functionless supernumerary masses of kidney tissue has been noted a number of times. The condition has no surgical interest. The presence of a supernumerary functionating kidney in man is extremely rare. Kretschmer[3] has reviewed the subject and reported a case. The operative diagnosis may be difficult.

The presence of three ureters usually means simply a bifurcation of the excretory apparatus, while in some of the reported cases of supernumerary kidney the ureter from this has joined the ureter from the other kidney of the same side before entering the bladder. Were

[1] Keyes, "Genito-Urinary Diseases," 1910, page 584.

[2] *Hospitals Tidende,* 1910, liii, 1481.

[3] *Jour. A. M. A.,* 1915, lxv, 1447.

the condition suspected it might be identified by pyelography. The operative treatment of surgical conditions occurring in the supernumerary kidney probably presents no peculiar difficulties.

ABNORMALITIES OF THE URETER

Absence of Ureter.—Absence of the ureter, of course, implies the absence of the corresponding kidney. Absence of kidney does not, however, necessarily imply absence of the corresponding ureter. A portion of this may persist, and may even be patent, though it is likely to be so narrow as not to admit a ureter catheter.

Reduplication of Ureter.—One of the commonest of anomalies of kidney and ureter is a bifurcation of the renal pelvis, each narrow pelvis leading into a separate ureter which extends for a short distance before the two join. Total reduplication is said by Wedensky[1] to occur in at least 1 per cent of cases, usually on the left side. The double ureter is often not associated with any notable malformation of the kidney, but a number of cases have been reported with infection in one of the pelves, but not in the other (cf. Stevens).[2] The condition has also led to confusion in diagnosis, since on one catheterization the urine appears normal, and on a subsequent one, perhaps by a different observer, the urine from the same kidney is found purulent. Indeed the condition has led to a false diagnosis of the spontaneous cure of renal tuberculosis.

The ureter from the lower kidney pole takes the normal course, and enters the trigone at its usual angle. The ureter from the upper pole is longer at both ends, it enters the bladder at some point below the angle of the trigone.

Crossed Ureters.—A fused kidney on one side of the median line necessitates the ureter to that kidney crossing the median line in order to get to its proper place in the bladder. Braasch has a unique illustration of a ureter crossing the median line to join the opposite ureter and then enter by one orifice into the bladder.

Abnormalities of Implantation.—Abnormal implantation of the ureter into the pelvis results in hydronephrosis (page 457). Abnormal implantation of the ureter in the bladder is usually associated with a supernumerary ureter. Hartman[3] has reported 37 cases of extravesical opening of the ureter, 14 of them were supernumerary. The orifice was in Gaertner's duct (2); the vestibule (21); the vagina (8); the urethra (6). Wedensky reports 2 cases of termination of the ureter in the prostatic urethra.

[1] *Folia Urol.*, Oct., 1911, page 345.

[2] *Jour. A. M. A.*, 1912, lix, 2298.

[3] *Zeitschr. f. Gynäk. Urol.*, 1913, iv, 69.

Much more frequently the supernumerary ureter terminates in some part of the trigone between its angle and the urethral orifice. If near the urethra, the abnormally situated ureteral mouth may lead to incontinence of urine. In this event the ureter may be reimplanted in the vault of the bladder or it may be resected with the portion of the kidney that empties into its pelvis.

Stricture of the Ureter.—Congenital stricture has been studied by Bottomley.[1] Strictures, valves and partial atresia have been noted in various portions of the ureter. They are commonest at the bladder orifice where they lead to the intravesical ureteral cyst (see below) and at a point at, or near, the entrance of the ureter into the bladder wall. With congenital stricture is usually associated a congenital dilatation of the ureter and kidney pelvis above. The stricture may be so slight that it causes no symptoms until adult life is reached, but the usual result is congenital hydronephrosis.

Intravesical Ureteral Cyst.—Stricture of the ureter, at its point of entrance into the bladder cavity, is not so very uncommon. The orifice may be reduced to so small a size that it would scarcely, or not at all, admit a ureter catheter. As a result the ureter above dilates, and especially that portion of it which lies underneath the mucous membrane of the bladder. This dilatation produces the so-called intravesical ureteral cyst. It may reach an enormous size, and may even be protruded from the urethra in the female. The smaller cysts are quite common and are associated with intermittent hydronephrosis as a rule. The obstruction is readily relieved by biting with the cystoscopic forceps or scissors a sufficiently large hole in the overlying mucous membrane of the bladder.

[1] *Annals of Surgery*, November, 1910.

CHAPTER LVI

MALFORMATIONS OF THE BLADDER AND URETHRA

MALFORMATIONS OF THE BLADDER

EXSTROPHY

Exstrophy or extroversion of the bladder (ectopia vesicae) is far more common in the male than in the female. Thus, of the 49 cases collected by Pousson,[1] 37 were men and 12 women. Neudoerfer estimates one case to 50,000 births and eight boys to one girl. Smeed reports 3 cases to 28,000 births (Edmunds [2]). In the female it does not prevent copulation. Cases of pregnancy and successful delivery at term are recorded.

The deformity is an arrest of development in the median line analogous to harelip, and is found in different degrees. In a typical case the lower abdominal wall and the front wall of the bladder are absent. The pubic bones are separated, their ends being united by a strong band of fibrous tissue. The posterior wall of the bladder, pressed out by the intestines, forms a mottled, red, tomatolike tumor, occupying the position of the symphysis pubis. Inguinal hernia of one or both sides is commonly present. The scrotum is usually normal, containing the testicles. The penis is rudimentary, and affected by complete epispadias. The ureters are sometimes greatly dilated, forming, as it were, rudimentary bladders. The pathology and etiology are given in detail by Connell [3] and Hovelacque.[4]

In exstrophy of the bladder the patient's condition is miserable indeed. The mucous membrane covering the protruded posterior wall of the everted bladder is inflamed, thickened, ulcerated, and covered by decomposing stringy mucous, the whole bathed in ammoniacal urine.

The integument of the abdomen and thighs becomes excoriated and inflamed. The friction of garments in walking only serves to aggravate the existing difficulties, and the sufferer is in a truly pitiable condition.

Vulliet [5] states that 41 per cent of the little sufferers die within

[1] *Guyon's Annales*, 1888, vi, 94, 155, 244, 337, 409, 471, 536, 615.
[2] *Practit.*, 1914, xcii, 501.
[3] *Jour. Am. Med. Assn.*, 1901, xxxvi, 637.
[4] *Jour. d'Urol.*, 1912, i, No. 2.
[5] *Lyon Chir.*, 1913, ix, 589.

5 years; 18 per cent in the next 5 years, and almost all the survivors perish before the age of 15. Death is usually due to renal infection.

Treatment.—Palliative Treatment. —This consists in wearing an appropriate urinal. No urinal can be well arranged for an infant or a young child, and at this time vaselin and hot water are our only arms against the disease. In later life a metallic shield, preferably of silver, sufficiently bulged to contain the protruding vesical wall without coming into contact with it may be worn. From the lower part, which is slightly bellied downward, extends a tube upon which is fitted a long, flat rubber bag, to be worn strapped to the thigh, and to serve as a reservoir for the urine (Fig. 112). The instrument may be kept clean by a weak solution of formalin.

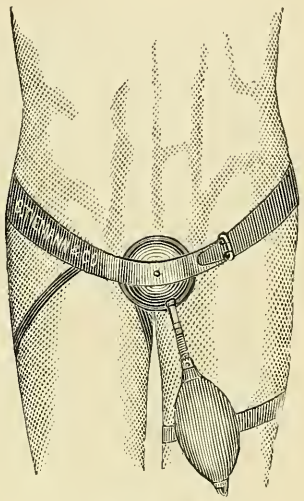


Fig. 112.

Operative Treatment. — Palliative treatment is inefficient, but operation should be postponed until the child is from six to eight years of age.

Of the many *plastic operations* that have been suggested, none reconstructs a bladder excepting Trendelenburg's.[1] The aim of this operation is to obliterate the cleft in the bladder and belly wall by bringing the pubic bones together. This is accomplished, first of all, by wearing a belt, subsequently by division of the sacro-iliac synchondroses. With the bones thus reunited, the bladder retracts into the pelvis, and the suprapubic fistula may be closed. The treatment requires several years. It is very difficult to reconstruct the sphincter.

Fig 113.—Sacculated Bladder. Due to prostatic retention.

The transplantation operations achieve somewhat better results; but

[1] *Berlin. klin. Wochenschr.*, 1915, lii, 9.

require great technical skill. Peter's is the easiest to perform; Maydl's sometimes succeeds. Coffey and Mayo have had great success with the technic devised by the former on condition that each ureter be

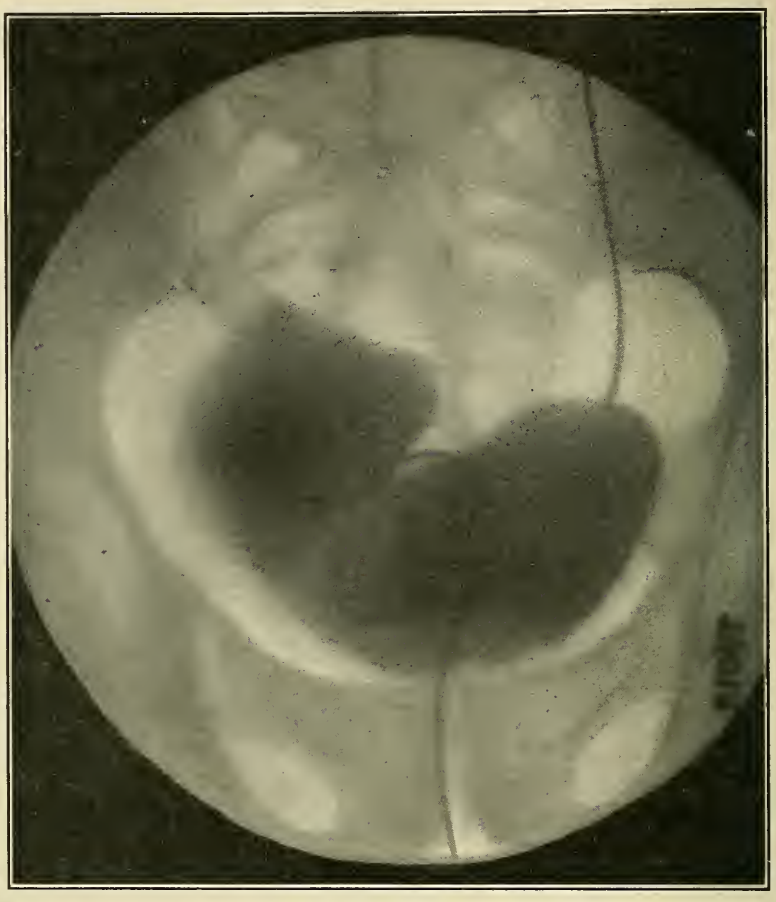


Fig. 114.—Cystography Showing Diverticulum. Visible catheter in opposite ureter.

transplanted separately. Cutaneous transplantation is not to be considered for children.

DIVERTICULUM

Probably most bladder diverticula are congenital. The so-called double bladder is a form of diverticulum. Multiple small diverticula evidently result from the back pressure of stricture and prostatism (Fig. 113), but the typical large diverticulum usually shows symptoms before the age of prostatism and often in a patient who has no history of venereal disease or evidence of stricture (Fig. 114). Fischer [1] con-

[1] *Surg., Gyn. & Obstet.*, February, 1910, page 156. See also Sherill, *Am. Jour. Urol.*, 1915, xi, 303.

cedes their congenital origin, but rejects the theory of Englisch, that the diverticulum is due to some obstruction in the urinary outflow which has subsequently disappeared. He believes with Badenstecher that the diverticulum is "produced by a folding in of the bladder wall brought about by a superfluity of embryonal tissue which has to accommodate itself to a certain space in the pelvis."

Pathology.—"The word diverticulum should, I think, be confined to those cases of pouches always of congenital origin occurring most frequently in certain positions but ocasionally seen in almost any portion of the bladder, and not due to defective development or lack of closure of any recognized structure" (such as the urachus) (Cabot).[1] The walls of diverticula are made up of the normal coats of the bladder, but their musculature is weak, and becomes rapidly destroyed by inflammation.

The usual situation for the orifice is not far behind or lateral to the orifice of the ureter. Indeed, the ureteral orifice may open within the diverticulum. Hydro- and pyonephrosis result from kinking of the ureter about a diverticulum; or from distortion of the orifice of the ureter, when this opens within the sac.

As a result of inflammation, stone may form in a diverticulum; tumors may also grow therein.

Symptoms.—The uninflamed diverticulum is practically symptomless. Therefore a patient may reach a considerable age before this congenital lesion gives any symptoms, though if the patient be intelligent, and the diverticulum large, close questioning will usually reveal the fact that there has been some unusual quality in urination, either an ability to hold an unusually large quantity of urine, or a difficulty of urination, extending back for many years.

The onset of symptoms (usually the age at which infection began) is shown in the following table made up of the cases collected by Fischer, Cabot and Lower.[2]

Below 20 years of age	3 cases
20 to 30	6 cases
30 to 40	10 cases
40 to 50	11 cases
50 to 60	8 cases
60 to 70	8 cases
70 to 80	3 cases

There were 59 men and 5 women.

The clinical picture is a combination of infection and retention. Among the younger patients, as a rule, the history is that a chronic

[1] *Boston Med. & Surg. Jour.*, 1915, clxxii, 300, 365.

[2] *Jour. A. M. A.*, 1914, lxiii, 2015.

gonorrhea does not get well, or that they have difficulty in emptying the bladder, and a catheter reveals a certain amount of residual urine. The older the patient, the more the symptoms of retention predominate, and hematuria may be added if there is stone or tumor. If the disease begins early in life the symptoms may be mild for many years. In

Fig. 115.—Cystography Showing Large Phlebolith Near Bladder. This might be mistaken for a diverticulum.

several of my patients the symptoms went back for more than ten years before cystoscopy revealed the true condition.

Diagnosis.—One may suspect the presence of a diverticulum whenever there is a prolonged chronic infection of the urethra or bladder with even a small amount of residual urine, or whenever there is residual urine otherwise unaccounted for. The diagnosis may usually be made by cystoscopy which reveals the orifice of the diverticulum. A ureter catheter passed into the diverticulum shows whether this is large enough to be worthy of comment or not. Before operating, the diagnosis is still further confirmed by cystophotography with the bladder filled

FIG. 1

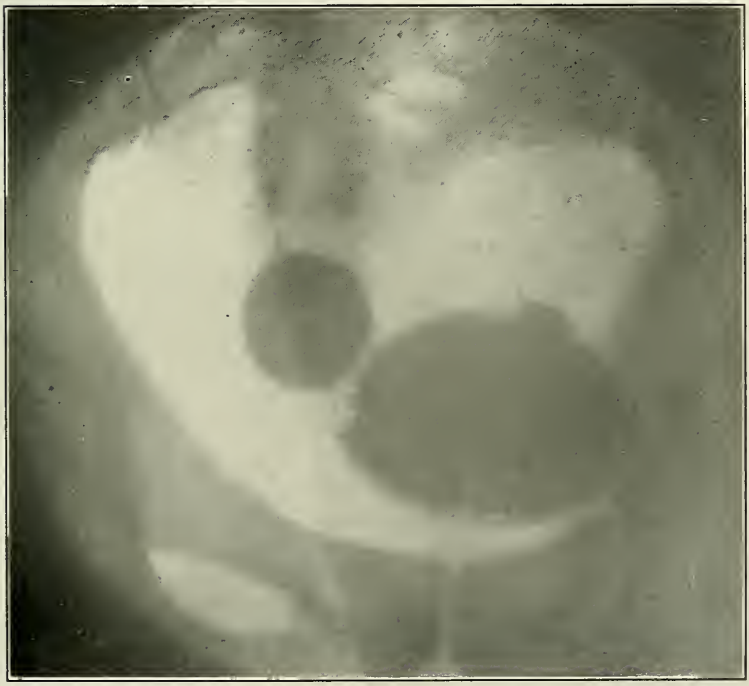


FIG. 2

STEREOSCOPIC CYSTOGRAMS OF DIVERTICULA.

FIG. 1.—Taken from the left, the small diverticulum stands out.
FIG. 2.—Taken from the right, the large diverticulum stands out.

with 5 per cent collargol or some other visible fluid (Figs. 114, 115). Since the pouches usually protrude to either side of the bladder radiographs should be taken at an angle similar to that usually employed in taking stereoscopic radiograms (Pl. XVIII).

Treatment.—The treatment is entirely operative (page 723). A diverticulum behind a large prostate should not be operated upon until after prostatectomy. Indeed, in most instances the prostatectomy sufficiently alleviates the symptoms.

URACHUS CYST, OR FISTULA

Toward the middle months of intra-uterine life the urachus (the canal connecting the bladder with the umbilicus) becomes obliterated. Exceptionally, it remains patent throughout or at one extremity. This patency gives rise to a urachus cyst,[1] or fistula,[2] as the case may be. Urachus cyst is exceedingly rare. I have seen one in an adult which formed a large, irregular, fluctuating, hypogastric tumor.

Urachus fistula is commonly a congenital condition, and is usually caused by urethral obstruction. The urachus may open in adult life as a result of urethral obstruction, but doubtless this does not occur unless there has been some congenital defect in the closure of the canal. Urachus fistula may be distinguished from fistulae resulting from the bursting of an abscess or from malignant infiltration.

The treatment of urachus cyst, or fistula, consists in the excision of the canal or cyst after the urethral obstruction has been removed. Indeed, some fistulae have been closed by merely removing the obstruction and curetting the canal.

MALFORMATIONS OF THE URETHRA

The urethra is subject to arrest and error of development, but is not often seriously deformed. Among curiosities of deformity may be mentioned abnormal position of the meatus on the side of the glans penis; termination of the ejaculatory ducts in a separate canal, running along the dorsum of the penis and opening behind the glans (gonorrhea of this canal has been noted); and termination of the urethra in the groin. Le Fort[3] has collected and classified the different varieties of fistula of the penis and the so-called double urethra, and shows that the second urethra is always a blind pouch, usually a prolongation of the

[1] Weiser, *Annals of Surg.*, October, 1906.

[2] Binnie, *Jour. Am. Med. Assn.*, 1906, xlvii, 109.

[3] *Guyon's Annales*, 1896, xiv, 624, 792, 912 and 1095. See also MacKenzie, *Surg., Gynec. and Obstet.*, 1916, xxii, 344.

lacuna magna. In fact, double urethra does not exist, except with double penis.

These deformities, dependent upon excessive and unnatural development, are exceedingly rare. Deformities caused by a defect of development are more common. Either the canal is obstructed or it is not closed in. In the former case the junctions among the various parts of which the canal is formed are incomplete (atresia—congenital stricture); in the latter the closure of the walls is defective (hypospadias—epispadias).

ATRESIA

Atresia, commonest at the meatus, may occur at any part of the canal. Indeed, the entire urethra may be replaced by a fibrous cord.

The obstruction is usually but a thin membrane which may be punctured and the orifice kept patent until it heals, after which no further trouble need be anticipated. If, however, the urethra is imperforate for some distance, it may be punctured with a small trocar, but only after the internal segment has been accurately located by external urethrotomy, or, if the membranous urethra is also involved, by suprapubic cystotomy. In these cases the urachus often remains patent, and the patient urinates through this. Removal of the urethral obstruction is soon followed by closure of the urachus. Englisch [1] has furnished a contribution to this subject. The stricture liable to ensue upon puncture of the diaphragm or of a band must be combated by the usual methods. Major surgical procedures are best delayed, if possible, until the patient has attained his sixth or eighth year.

CONGENITAL STRICTURE

Congenital stricture, usually of the meatus, is so common, and has such a direct bearing upon the treatment of the so-called organic stricture, that it is considered in that connection.

I have seen several congenital strictures elsewhere in the canal, usually in its scrotal portion. These are usually mistaken for gonorrheal strictures. But careful dissection reveals a congenital overriding of the two ends of the canal which is pathognomonic of congenital stricture.

DILATATION OF THE URETHRA

Bokay [2] has collected 14 cases of congenital urethral diverticula, only 3 of which were due to stricture.

[1] *Arch. f. Kinderheilk.*, 1881, ii, 85 and 291.

[2] *Dermatolog. Zeitschr.*, 1900, vii, 721.

PROLAPSE OF URETHRA IN LITTLE GIRLS

"Brüning [1] reports a case of the sudden prolapse of the entire mucous lining of the urethra, without apparent cause, in a healthy girl of 8. Study of the literature on this subject shows that this occurrence is observed in girls only in early infancy and between the ages of 8 and 12. Hemorrhage accompanied the prolapse in 41 per cent of the seventy-six cases he has found and tabulated. In a large proportion of the cases the prolapse was not recognized and dire results followed the treatment based on a mistaken diagnosis. The child should be kept in bed and astringent and cauterizing measures should be applied after reduction. If these fail or if the prolapse is total, he advises resection of the sagging portion and suture. The operative loss of blood has always been slight."

HYPOSPADIAS

Hypospadias is that form of imperfect development of the urethra in which the canal terminates in an opening in its lower wall instead of extending to its normal termination in the end of the glans penis. There are three degrees of hypospadias: (1) *balanitic hypospadias,* in which the urethra opens on the lower surface of the glans or at the penobalanitic junction; (2) *penile hypospadias* (penoscrotal and scrotal hypospadias), in which the canal opens on the under surface of the penile urethra, usually at the penoscrotal angle; and (3) *perineal hypospadias,* in which the urethra terminates in front of the triangular ligament and opens in the perineum. Thus hypospadias always occurs in front of the cut-off muscle, and, no matter how extensive it may be, the patient has control over the escape of urine. Hypospadias at the penoscrotal angle is more common than the perineal variety, and most frequent of all is balanitic hypospadias. That part of the urethra lying between a hypospadial opening and the meatus is usually absent.

Hypospadias, as commonly encountered in practice, consists in an absence of the frenum preputii and a flaring open of the meatus inferiorly, or an opening in the floor of the canal within a few lines of the natural meatus, the position of which latter is usually marked more or less perfectly in its usual site. The hypospadic urethral orifice is always contracted. With penile hypospadias there is usually some downward curvature of the penis, and not infrequently adhesion of the penis to the scrotum: the condition may be called one of permanent physiological chordee. The penis, freed of all cutaneous and urethral attachments, cannot be straightened until the fibrous sheaths of both corpora have been transversely incised beneath, and sometimes not until the fibrous septum has been incised.

[1] *Jahrb. f. Kinderh.,* 1911, lxxiv, 1 (by *Jour. A. M. A.*).

With perineal hypospadias the scrotum is bifid, and the penis is usually very imperfectly developed, imperforate, and looks like a large clitoris. The bifid scrotum passes very well for a vulva. This is a common type of pseudohermaphrodite.

Etiology.—Hypospadias is a simple arrest of development in a portion of the lower wall of the urethra, its lateral halves failing to unite in the median line. In favor of this view are the manifest hereditary tendency to this deformity seen in some cases, and the fact that at two months the embryo has hypospadias normally. The scrotum has not yet united, and if natural development ceases here the last degree of hypospadias results. It may be urged that this theory does not explain the incurvation of the penis, nor its adhesion to the scrotum, nor the scarlike contracted appearance of the orifice. To explain these facts Kaufmann [1] advanced the theory that hypospadias and epispadias are examples of congenital fistula dependent upon imperfect union of the penile and the balanitic urethra. These two portions of the canal, it is known, are developed separately, and if imperfectly approximated atresia at the penobalanitic junction may result. Now, Kaufmann supposes that the urine secreted by the fetus may break either through the obstruction, leaving congenital fistula, or through the floor of the canal, producing hypospadias, or through its roof, thus causing epispadias. This theory explains incurvation and adhesion but not malposition of the urethra in epispadias, or exstrophy of the bladder, with nonunion of the symphysis pubis—phenomena so closely related to epispadias that no theory which does not elucidate them can be invoked to account for the urethral deformity.

Symptoms.—Balanitic hypospadias is unimportant; many patients have it without being aware of the fact, while the greatest inconvenience it produces is a slight imperfection in erection and a dribbling at the end of urination. With penile or perineal hypospadias, however, the patient may be forced to urinate in a squatting posture to keep from wetting himself, erection may be very imperfect, and there may be impotence from inability to throw the semen into the vagina.

An associated inconvenience is the necessity of enlarging the contracted meatus, in order to introduce dilating instruments, in case of stricture.

Treatment.—For *balanitic hypospadias* no treatment is actually necessary unless a meatotomy to permit the introduction of instruments into the urethra.

But if the patient demands radical operation, Beck's procedure should be employed.

For penile and perineal hypospadias operation is always required (p. 768).

[1] "Deutsche Chirurgie," 1886, 1 (a), 60.

EPISPADIAS

Epispadias is a fissure of the superior wall of the urethra with ectopia of the canal (Guyon). It is extremely rare. According to Baron,[1] epispadias occurs once for 150 cases of hypospadias, but Marshall did not find a single case of epispadias in examining 60,000 conscripts.[2] The epispadias may be balanitic or penile, or the urethra may be entirely laid open. This complete epispadias is almost always accompanied by exstrophy of the bladder. The epispadic orifice is large, and sometimes the finger may even be passed through it into the bladder. The prepuce forms a knob of loose tissue below the glans. The penis is short and thick, or small and more or less deviated. It is usually adherent to the scrotum, sometimes practically buried in it. The pubic bones may be separated even when there is no exstrophy of the bladder, and there may be hernia of that organ without exstrophy.

Etiology.—The observations made upon the etiology of hypospadias apply equally well to this condition. Epispadias is certainly an arrest of development in the upper wall of the urethra, but it is still a matter of hypothesis how the urethra gets above the united corpora cavernosa; for even when the genital buds which are to form the corpora cavernosa are still separate at the fortieth day of fetal life, the urethra is beneath them. With exstrophy of the bladder, where the lower portion of the abdominal wall is lacking and the pubic bones do not come together, it is easier to understand how the roof of the urethra may be wanting throughout.

Symptoms.—The symptoms consist in the functional derangement of micturition, erection, and emission, as in hypospadias; but it is to be noted that incontinence of urine, which never complicates hypospadias, is usually the main feature of severe cases of epispadias, and this cries out for operation more loudly and incessantly than even the most aggravated symptoms of hypospadias. Unfortunately, it is precisely here where operations are most in demand that they accomplish least.

Treatment.—For the milder cases, uncomplicated by the loss of sphincter power, the counsel to bear their woes patiently is a good one. The methods hitherto employed to relieve this condition—even the favored procedures of Thiersch and Duplay—are tedious and fraught with failures. In view, however, of the success of the Nové-Josserand operation for hypospadias, I should be tempted to try it for simple penile epispadias. In addition to the changes obviously necessary to adapt the operation to epispadias it would be necessary to divert the

[1] Dolbeau, *op. cit.*, p. 11.

[2] Englisch (*Bull. méd.*, Paris, 1895, ix, 153) has reported a case of complete separation of the penis into lateral halves, each corpus cavernosum forming a penis by itself, and the urethra opening between them.

stream of urine, and it might seem advisable to connect the new and the old urethra by continuing the graft into the outer extremity of the epispadic urethra previously denuded.

When the sphincter is lost it cannot be replaced.

The complicating adhesions, torsion or flexion of the penis, must be dealt with here, as in hypospadias, by liberating incisions of the skin and the sheaths of the cavernous bodies.

CHAPTER LVII

DISEASES OF THE SCROTUM

ANATOMY

The *scrotum* is a pouch formed of skin and of muscular and connective tissue. Its function is to contain and support the testicles. It is developed from lateral halves which unite centrally in the raphe, a raised line continuous with the raphe of the penis and that of the perineum. The integument of the scrotum is delicate in structure, covered with a few hairs, and likely to become pigmented at puberty. The sebaceous glands are very large.

The dartos is a layer of unstriped muscle firmly attached to the integument, and reflected inward from the raphe, to form the septum scroti. On exposing the scrotum to the air, the vermicular contractions of this muscle can be readily seen. They occur under the influence of cold or fright, and during the venereal orgasm. In youth, especially in winter, the dartos is habitually contracted and holds the testicles well up under the pubes. The ancient sculptors did not fail to notice that contraction of the scrotum was a mark of general as well as of sexual vigor. In the aged and infirm, however, especially during the summer, the muscle relaxes, allowing the testicles to hang low.

The septum scroti is pervious to fluids, so that serum or infiltrated urine can find its way readily from one side to the other. *The lymphatics* of the scrotum are large and numerous and lead to the inguinal glands.

The connective tissue within the scrotum, like that of the penis, is practically devoid of fat. The muscular dartos, described above, is the only layer of importance. The space between it and the testicle is filled with a loose mesh of fascia within which run the scattered fibers of *the cremaster muscle,* and beneath which the infundibuliform fascia, derived from the transversalis fascia, forms the investment of the spermatic cord.

ANOMALIES

The scrotum develops independently of the testicles, but if the latter fail to descend it remains rudimentary.

Failure of union between the lateral halves of the scrotum constitutes one of the features of pseudohermaphroditism.

CUTANEOUS DISEASES

The scrotum may be affected by most of the diseases of the skin. Only those that are modified by their position deserve notice.

Eczema.—Eczema attacking the scrotum and the surrounding parts is sometimes excessively obstinate and prone to relapse.

Acute eczema, urticaria and dermatitis venenosa result in an enormous edematous swelling.

Intertrigo.—Intertrigo occurs in children and in fat men of rheumatic habit. Much can be done to prevent it by scrupulous cleanliness, and the use of a suspensory bandage to keep the cutaneous surfaces apart. To overcome the hyperemia, rest, cleanliness, and exposure of the parts to the air are speedily effective in mild cases. If the surface is moist and excoriated, it should be dusted with equal parts of finely powdered oxid of zinc, camphor, and starch, or it may be dressed with the oxid of zinc ointment or with a solution of sulphate of zinc. A strip of old thin linen should be used to sling up the scrotum and keep the cutaneous surfaces apart. Later, when the parts are dry, compound tincture of iodin, at first considerably diluted with water, locally, will hasten the cure.

Pityriasis.—In men with a delicate skin, especially in summer, there is often a slightly brown discoloration of the thigh and the scrotum, where the two surfaces lie habitually in contact, caused by a vegetable parasite in the upper layers of the epidermis. It sometimes gives rise to a mild local erythema and considerable itching. A few applications of the compound tincture of iodin diluted to half strength, and painted on after the affected skin has been washed with soap and dried (to remove the fat from the scales and spores), will cure the discoloration and the itching. Sulphurous acid does well.

Eczema Marginatum.—This is another parasitic disease, affecting the scrotum, thighs, mons veneris, and buttocks. It is not an eczema, but a herpes tonsurans vesiculosus—a combination of herpes tonsurans and intertrigo, as proved by Pick.[1] The eruption commences in one or more small, round patches, red, elevated, and itchy, just where the scrotum habitually lies in contact with the thigh. It spreads circumferentially, healing in the center. The border of the eruption is sharply defined, and forms the distinctive feature of the disease. It is composed of papules, vesicles, excoriations, and crusts. The parts within this festooned border over which the disease has passed are left of a

[1] *Archiv f. Derm. und Syph.*, 1, iii, 443.

brown color. Often, little heaps of dried-up scales lie here and there upon this surface. Patches of eruption break out in the neighborhood or within the border, and behave exactly like the patches first constituting the disease. The affection is slow in getting well and tends to relapse. Friction and moisture of the parts, together with the parasite, are necessary for its production. Among the scales scraped from the margin, the microscope may detect the moniliform filaments and spores of the tricophyton of Malmster. In certain stages of the disease the parasite is difficult to find.

Treatment.—Dilute lead-water or oxid of zinc ointment may be used locally at first if there be much inflammation of the skin, to be followed by parasiticide lotions, or the latter may be commenced with at once. The best of these is a mild solution of corrosive sublimate (1: 10,000), which should be kept constantly applied. Sulphurous acid, pure, is an excellent parasiticide; or compound resorcin ointment (N. F.). Treatment should be kept up for some time after apparent cure, as relapses are the rule, and can only be averted in this way.

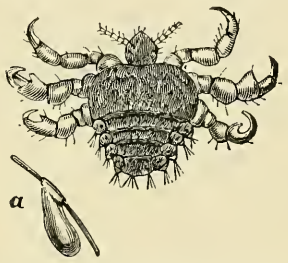


FIG. 116.—PEDICULUS. *a*, Nit attached to hair.

Pediculi Pubis.—These parasites may be found upon the scrotum, as they may, in fact, upon any part of the body from which the hairs of puberty grow. They exist in greatest abundance, however, about the genitals, and particularly on the mons veneris. They are plainly visible to the naked eye, as are their eggs attached to the hairs (Fig. 116).

Mourson,[1] a French naval surgeon, first pointed out the relation between certain blue spots on the skin and pediculi pubis, and Douguet confirmed the relationship by inserting a bruised pediculus under the skin and producing a spot. Mallet proved that the coloring matter resides in the salivary glands of the pediculus.

No treatment is better than the old-fashioned blue mercurial ointment, which may be rubbed into the hairy parts about the pubes and perineum and somewhat down the thighs, the patient going to bed in drawers and sleeping covered with the ointment all night. Two such applications, at a few days' interval, usually destroy the colony. The treatment is a very dirty one, and much soap and hot water form essential parts of it.

INJURIES OF THE SCROTUM

Wounds.—Wounds of the scrotum, whether surgical or accidental, give rise to free bleeding. This must be entirely controlled by ligature

[1] *Lancet*, 1882, ii, 454.

before the wound is sutured, for in the lax scrotal tissues an insignificant oozing may give rise to an enormous hematoma extending to penis, thighs, and abdomen.

As a further precaution, the scrotum should be compressed beneath the adhesive plaster dressing described on p. 575.

Loss of Tissue.—When any considerable portion of the scrotum is destroyed by gangrene, accident, or the knife, the rapidity with which the defect covers in is little less than marvelous.

Castration need never be performed, however great the loss of integument. Kocher's [1] case, in which both testicles were practically covered over by skin in the short space of three weeks, shows what brilliant results may be obtained by expectant treatment. The surgeon need only help with tension sutures and aseptic dressings.

Hematoma and Hematocele.—Contusions of the scrotum give rise to extensive ecchymosis and edema quite comparable to the familiar black eye. If seen early the hemorrhage may be checked by adhesive plaster compression and an ice-cap. Later heat promotes absorption. The hematoma may have to be incised.

INFLAMMATIONS OF THE SCROTUM

Inflammatory Edema.—Extensive edema may complicate any inflammation of the scrotum on account of the laxity of its tissue.

Where edema is excessive, and the tension so great that injury to the skin seems imminent from pressure, a few punctures may be made on each side of the raphe, at the most dependent point of the scrotum. These punctures should be protected by a wet dressing to encourage oozing, to improve the circulation, and to prevent infection. In milder cases, strapping (p. 575) will quickly reduce the edema, if the cause has been removed and a suspensory bandage is applied.

Cellulitis and Abscess.—Cellulitis and abscess of the scrotum are encountered clinically as phenomena of urinary infiltration (p. 265).

Erysipelas.—Scrotal erysipelas is peculiarly virulent.

In the beginning, the rapidity of invasion and the superficial nature of the lesion distinguish it from urinary infiltration. Later the two closely resemble each other.

Treatment.—Multiple free incisions parallel to the raphe, and 1 per cent carbolic acid wet dressings should be employed.

Gangrene.—Gangrene of the scrotum, whether due to urinary infiltration, infection, or injury, usually involves the greater part of the scrotum. The testicles are always spared and swing bare and bald. Coenen [2] has collected 206 cases with a mortality of one in five.

[1] "Deutsche Chirurgie," 1887, 1 (b), 8. [2] *Beitr. z. klin. Chir.*, August, 1911.

Treatment.—The condition is desperate unless *immediately* submitted to the knife. All the gangrenous tissue must be cut away (the urethra opened and the bladder drained by a perineal tube if there is stricture), and the testicles supported in wet dressings. Castration is never indicated.

The skin of the scrotum heals with such marvelous rapidity that plastic operations are rarely necessary.

Diphtheria.—Le Clerc [1] has observed and collected a number of cases resembling, clinically, an acute erysipelas, and which he attributes to diphtheria, the Klebs-Loeffler bacillus having been cultivated, either pure or in mixed culture, from the wound discharges.

Emphysema.—This occurs with general subcutaneous emphysema and with scrotal gangrene.

Scrotal Fistula and Calculi.—These are of urethral origin.

ELEPHANTIASIS, LYMPH SCROTUM, LYMPH VARIX

Elephantiasis is a condition of chronic distention of the lymph vessels of any part of the body, whereby the skin and subcutaneous tissues become thickened and indurated and the part often enlarges to an incredible size. It occurs usually in the lower extremity and in the penis and scrotum.

Etiology.—The cause of elephantiasis is obstruction of the lymph channels. Thus scrotal elephantiasis may follow extirpation of the inguinal glands.[2] Severe chronic inguinal adenitis may have the same unhappy effect. But the enormous elephantiasis, so frequent in the tropics, is due almost always to the *filaria sanguinis hominis*. The fascinating life history of the filaria has been studied by Lewis,[3] Manson,[4] Le Dentu,[5] Mastin,[6] Lothrop and Pratt,[7] and many others. Born in some marsh or swamp, the embryo enters a man's alimentary canal in a sip of water. Thence it makes its way to the lymphatics, where it settles down for life and attains its full development. Here it is impregnated and pours into the blood current an infinite stream of embryos. By night the blood is alive with them, by day not one can be found where, a few hours before, were myriads. Where they hide no one knows. But in the human host they cannot develop. To reach

[1] *Guyon's Annales*, 1898, xvi, 1102.

[2] Cf. *Bull. soc. française de dermat. et syph.*, 1898, ix, 292.

[3] "On a Hematozoön Inhabiting Human Blood," 1872, Calcutta.

[4] *Med. Times and Gazette*, 1875, ii, 542, 566; *Trans. Path. Soc.*, 1881, xxxii, 285; *Brit. Med. Jour.*, 1899, ii, 644.

[5] *Revue de chir.*, 1898, xviii, 1.

[6] *Ann. of Surg.*, 1888, viii, 321.

[7] *Am. Jour. of Med. Sciences*, 1902, cxx, 525.

maturity they must be sucked up by a mosquito—a night-prowling insect. The mosquito, gorged with blood, returns to deposit her eggs and die in his (or rather her) native swamp, where from her corpse arise the filaria ready to develop, to infest the water, and again to be swallowed by some unsuspecting man.[1]

So much for the romance. The sorry fact is that these embryos, no larger than a leukocyte, become impacted in the lymph glands or channels in such a way as slowly and progressively to obstruct the lymph flow. If this happens in the lower inguinal glands, elephantiasis of the lower extremity results; if in the upper chain, the scrotum and penis are affected; if in the iliac glands, *lymph varix* and *lymphadenoma* of the spermatic cord may result.

Chyluria (or hematochyluria) and *chylous hydrocele* are caused by rupture of a dilated lymphatic vessel into the cavity of the urinary tract or into the tunica vaginalis.

Symptoms.—Elephantiasis begins with recurring attacks of dermatitis and edema accompanied by fever. At first, there is between the attacks only a brawny patch upon the skin and a slight enlargement of the inguinal glands. As the disease progresses, the skin and subcutaneous tissues become thickened by an overgrowth of dense fibrous elastic tissue, and the vessels, especially the lymphatics, become enormously dilated. As the scrotum enlarges it drags down the skin of pubes and perineum and inverts the skin of the penis, leaving, finally, no trace of that organ, except a transverse slit on the anterior surface of the tumor. This reaches incredible proportions. Wilkes removed a scrotum weighing 165 pounds, and Larrey mentions one weighing 200 pounds.

Treatment.—The *prophylaxis,* avoidance of unboiled drinking water in the tropics, need scarcely be insisted upon. *Curative* treatment is surgical. Fortunately, ablation of the hypertrophied tissues is rarely followed by recurrence, though such an operation does not pretend to affect the mother worm or her ovulation. The chief danger of operation is the bleeding. This was successfully controlled in an operation for vulvar elephantiasis, at which I had the pleasure of assisting, by Wyeth's hip pins and an Esmarch bandage.[2] It is essential to remove as much as possible of the indurated tissue, and yet to leave flaps to cover the testicles and penis. Radical cure of hernia may also be required. The strictest asepsis should be observed to avoid lymphatic absorption. In the smaller cases the inguinal glands may be removed.

[1] Of late years there is a tendency to consider the mosquito the adequate intermediate host, as is the case in malaria. I have sketched the classic theory, although it will perhaps be proved incorrect.

[2] Bullard, *Med. Record,* 1899, lv, 128.

TUMORS OF THE SCROTUM

Cysts.—Small sebaceous cysts, shining white through the distended skin, occur on any part of the scrotum, but particularly on the raphe. They sometimes attain startling dimensions. Echinococcus cysts have been met with. A urinary pocket opening into the urethra behind a stricture has been mistaken for hydrocele. Jacobson gives a detailed account of two cases of cystic disease of the scrotum, to which Tilden Brown [1] has added a third.

Multiple minute blood cysts, varying in size up to that of a large pinhead, and sprinkled abundantly over the entire scrotum, are sometimes found after middle life. They are of a dark-blue color and give rise to no changes in the skin and to no symptoms whatsoever, excepting their appearance, which annoys the patient. They may be cured permanently by touching each one separately with an electrocautery, or pricking it and touching the raw surface with a nitrate of silver point.

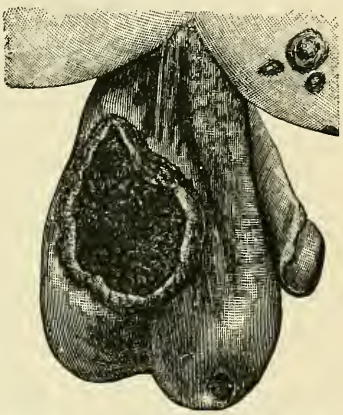


Fig. 117—Epithelioma of the Scrotum in a Paraffin Worker. Three ulcers on the right buttock.

Cases of *angioma, angiokeratoma,*[2] *fibroma, lipoma, fibromyxoma, osteochondroma,* and *sarcoma* have been reported.

Epithelioma of the Scrotum (*Chimney-Sweeps' Cancer*).—Soot seems to be the exciting cause of scrotal epithelioma (Fig. 117) in England, although in other countries those whose occupation brings them into contact with this substance do not seem to suffer. Thus Warren [3] states that he has seen it a few times in this country, but never among chimney-sweeps. I have seen but three cases.

The disease begins as one or more small, soft warts or tubercles, usually at the lower forepart of the scrotum. These remain unchanged for a time, but finally indurate slightly, become excoriated, scab over, and ulcerate, the ulcer extending backward, and destroying, with more or less rapidity, the whole scrotum. The ulcer has hardened, irregular, purplish, everted, knotty borders; a hard, uneven, unhealthy looking base.

Exceptionally the warty growth develops into a large cauliflower-like mass (Fig. 118).

[1] *Jour. of Cut. and Gen.-Urin. Diseases,* 1895, xiii, 33.

[2] Sutton, *Jour. A. M. A.,* 1911, lvii, 189.

[3] "Surgical Observations on Tumors," p. 329.

Death occurs by exhaustion, or by hemorrhage, if a large vessel be severed by the advancing ulceration. The disease continues local

Fig. 118.—Scrotal Epithelioma.

for some time. It is only tardily that the inguinal glands become involved.

Treatment.—Radium or x-ray may cure early cases. Large lesions require surgery of the most radical sort—with extirpation of the inguinal glands.

CHAPTER LVIII

ANATOMY, PHYSIOLOGY, EMBRYOLOGY, AND ANOMALIES OF THE TESTICLE

ANATOMY

The testicles (Fig. 119), each suspended by its spermatic cord, lie loosely in the scrotum, surrounded by connective tissue. The left usually hangs lower than the right. The mean dimensions of the testicle (Curling) are $1\frac{3}{4}$ inches long, $1\frac{1}{4}$ inches anteroposteriorly, and 1 inch laterally. Two of the envelopes of the cord, the cremaster muscle and the infundibuliform fascia, also cover the testicle, while the gubernaculum attaches it to the bottom of the scrotum.

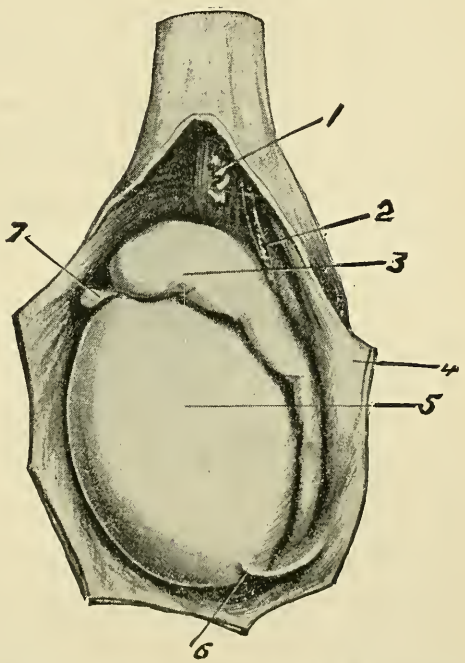


Fig. 119.—Left Tunica Vaginalis Opened, Showing Testis, Epididymis, etc., from Outer Side. 1, Organ of Giraldès; 2, vas deferens; 3, globus major of epididymis; 4, 6, tunica vaginalis; 5, testicle; 7, hydatid of Morgagni. (Quain.)

Tunica Vaginalis. — The proper coverings of the testicles are two—the tunica vaginalis and the tunica albuginea. The former is a closed serous sac, investing all the secreting portion of the testicle, except where the epididymis is attached behind and the gubernaculum below. It dips down posteriorly, between the epididymis and the testicle. On the outer side the tunica vaginalis covers and closely invests the epididymis. The sac extends up the cord to a greater or less extent.

The tunica vaginalis represents a portion of the peritoneum carried down by the testicle in its descent from the abdomen. Ordinarily, at

birth, all connection between its cavity and that of the peritoneum is closed, a white, fibrous line (habenula) alone marking the original continuity of membrane. Sometimes, however, the opening persists, in which case congenital hernia is likely to occur; or the communication may be a narrow canal, open to the passage of fluid only; or again, partial obliteration may occur, isolated serous sacs being left along the cord; finally, it more often happens that the upper aperture is closed, and a considerable portion below remains unobliterated, so that the tunica vaginalis extends for some distance upward in front of the cord.

The cavity of the tunica vaginalis is lined by pavement epithelium, and normally contains only enough fluid to lubricate the surfaces.

Tunica Albuginea.—The tunica albuginea is the proper investing membrane of the secreting portion of the testicle. In its substance the branches of the spermatic artery ramify and break up, to be distributed to the seminal tubules within. It is composed of dense, white, fibrous tissue, is very inelastic (whence the pain in orchitis), and sends trabeculae into the substance of the testicle to break it up into compartments for the lodgment of the tubuli seminiferi. It forms the mediastinum (corpus Highmorianum) above and behind, where the vessels pass to and from the testicle, and where the straight tubes come out to form the coni vasculosi in the head of the epididymis.

Glandular Substance.—The glandular substance of the testicle consists of innumerable little tubes (tubuli seminiferi) closely packed in conical segments between the fine, fibrous septa thrown out by the tunica albuginea. The number of these cones is computed to be from 250 to about 500, and their combined length from 1,000 to 5,500 feet.

They consist of a membrana propria, within which are several layers of epithelial cells, the outer ones polyhedral, those nearer the lumen spherical. These latter are known as spermatoblasts, and from them the spermatozoa are evolved. Section through a tubule shows the stages of this process by which the cells become pear-shaped, tailed, and finally full-fledged spermatozoa.

Issuing from the apices of the cones the tubes unite to form 20 or 30 tubes (vasa recta), which run straight into the fibrous mediastinum, and there form an irregular plexus of channels with no proper walls (rete testis). Issuing hence the ducts, now known as vasa efferentia, pierce the tunica albuginea to form the epididymis.

The Epididymis.—The epididymis caps the testicle proper and skirts its posterior border. It begins above, where the vasa efferentia issue through the tunica albuginea. These canals immediately dilate and collect in convoluted cones (coni vasculosi), forming the broadest part of the epididymis, the head or *globus major,* which lies over the top of the testicle. The coni vasculosi all empty into one canal—the canal of the epididymis, which forms by its convolutions the central

part or body of the epididymis. This body is separated from the testicle proper by the *culdesac* of the tunica vaginalis. Below, the canal of the epididymis exhibits further convolutions. At this point it is known as the *globus minor,* or the tail of the epididymis. Connective tissue unites it to the testicle to this point, and from here on the canal becomes more dense, and is known as the vas deferens.

The little supernumerary diverticulum (or there may be several), known as the *vas aberrans* of Haller, when present, usually empties into the canal of the epididymis at this point. The canal of the epididymis is furnished with ciliated epithelium whose cilia sweep toward the vas deferens.

There exist normally upon the head of the epididymis several little prominences, solid and cystic, known as the hydatid of Morgagni, or pediculated hydatid, the corpus innominatum of Giraldès, and the non-pediculated hydatids. They are the remains of the wolffian body and of the duct of Müller.

The blood supply of the testicle and epididymis is derived from the spermatic artery. *The lymphatics*[1] empty into the lumbar (not the inguinal) glands.

PHYSIOLOGY

External Secretion.—The function of the testicle is to form spermatozoa, the male procreative seed. These are not a secretion, but an evolution of the spermatoblasts of the seminal tubulus. Thence they issue by force of their own motility to the epididymis, where their transit is hastened by the ciliated epithelium. From the vas deferens they are collected in the seminal vesicle and ampulla, whence they are ejaculated during the sexual orgasm.

Internal Secretion.—The so-called internal secretion of the testicles has been studied anew of late years in connection with the discussion over the propriety of castration for hypertrophy of the prostate. It has long been known that the testicles are essential to a virile adolescence, since castration in infancy produces the recognized type of high-voiced, effeminate eunuchs. The familiar contrast between ox and bull, horse and stallion, is equally to the point.

This internal secretion is derived from cells lying in the stroma of the testicles, between the tubules.

Thaler and Kasai have made systematic studies of the life history of the interstitial cells, from fetal life into senescence. They have shown that these elements are extremely abundant during the fourth and fifth months of fetal life, and that after birth they rapidly diminish in number and are not much in evidence until the time of puberty, when they undergo a renewal of growth.

[1] Jamieson, *Lancet,* Feb. 19, 1910; Hinman, *Jour. A. M. A.,* 1914, lxiii, 2009.

Mitoses, however, are rarely if ever, observed. During middle life they remain approximately constant, according to Thaler, or diminish somewhat in numbers, according to Kasai (Pappenheimer and Schwartz).[1]

EMBRYOLOGY

The two constituent parts of the testicle, which have been briefly described above, are developed separately in the fetus. The epididymis is formed from the lower part of the wolffian body, and its duct is a continuation of the wolffian duct to the lower and back part of the bladder. Thus the epididymis may be regarded embryologically as the lower part of the kidney. As such Belfield believes it a secretory organ and as liable to hematogenous infections (notably primary tuberculosis) as the kidney. The secreting portion of the testicle, on the other hand, is formed from fetal tissue lying in front of, but seemingly independent of, the wolffian body.

The Descent of the Testicle.—The testicle develops in front of the wolffian body, resting upon the brim of the true pelvis near the site of the future inguinal canal, which at this period (fifth month) is represented by the *processus funiculovaginalis,* a pouch of peritoneum running into and terminating among the muscle fibers of the abdominal wall, through which it ultimately extends into the scrotum. This pouch offers a resting place into which the testis tends to work its way, aided by the *gubernaculum testis,* a fibromuscular cord attached above to the testis, epididymis, and spermatic cord, below to the abdominal wall, the inner surface of the pubes, the bottom of the scrotum, the perineum, and by a few fibers to the thigh over the saphenous opening. Guided, or perhaps pulled—the point is disputed—by the gubernaculum, the testicle settles into the peritoneal pouch, and with it sinks gradually through the abdominal wall and into the scrotum. The stronger fibers of the gubernaculum, fastened to the bottom of the scrotum, persist in adult life as a fascial band, while the processus funiculovaginalis, inverted by the descent of the testis, becomes the tunica vaginalis. The part of the processus above the testis is obliterated by adhesion of its opposed surfaces, beginning at both ends, above at the internal abdominal ring, below quite near the testicle. When adhesion is complete only a fibrous cord, the *habenula,* remains.

The descent of the testicle into the scrotum occurs during the last six months of intra-uterine life.[2] Indeed, in 10 per cent or 20 per cent

[1] *N. Y. State Jour. of Med.,* 1910, x, 548. This exhaustive monograph suggests that other internal secretions also share in determining the virile characteristics.

[2] Only mammals, and not all of them, have extra-abdominal testes, while some mammals retain the testes within the abdominal cavity, except during the rutting season, when they become congested and are extruded into the scrotum.

of all children the testicles are still in the abdomen at the time of birth. In most of these the testicles descend during the following weeks, but a small proportion are retained for years, or even permanently. The clinician need take no account of the position of the testicle during the first year, but if it is retained for longer than this the condition is definitely abnormal.

ANOMALIES OF THE TESTICLE

Monod and Terrillon's classification of anomalies of the testicle is the following:

Anomalies in development.	In number...	In excess	Polyorchism.
		Deficient — Absence...	Anorchism.
		Deficient — Fusion....	Synorchism.
	In size.....	In excess.....	Hypertrophy.
		Deficient	Atrophy.
Anomalies in migration...	Undescended	Incomplete migration.	Retention.
	Undescended	Abnormal migration.	Ectopia.
	Descended		Inversion.

I. Anomalies in Development.—Polyorchism.—Though many instances of supernumerary testis have been reported, and the condition is known to exist in the lower animals (Jacobson), the alleged instances in man have proved to be pedunculated tumors, encysted hydrocele, omental hernia, or have lacked the proof of a pathological examination, with the exception of the case reported by Arbuthnot Lane,[1] in which the diagnosis was confirmed by a microscopical examination of the supernumerary organ.

Anorchism.—The testicle may be lacking on one or both sides. With absence of the testicle is associated:

1. Usually absence of the epididymis and part of the vas, or
2. Exceptionally, entire absence of the seminal duct up to the vesicle, or
3. Still more rarely, the testis only is wanting, while
4. The testis may be present and the vesicle, epididymis, and vas absent.

During life anorchism cannot be differentiated from abdominal cryptorchism, except by operation. I have never seen a case.

Synorchism.—Jacobson cites the cases of Cruveilhier and Lockwood, the one in an adult, the other in a fetus, of intra-abdominal testicular fusion.

II. Anomalies in Migration. — Cryptorchism. — *Cryptorchism* means absence of one or both testicles from the scrotum, and their

[1] *Brit. Med. Jour.*, 1894, ii, 1241.

presence elsewhere, in contradistinction to *anorchism,* meaning total absence. *Monorchism* is unilateral cryptorchism. A *retained testis* is one that has been arrested at some point in its normal descent. An *ectopic testis* is, strictly speaking, one that has lodged at some point out of its normal course. The term "ectopia testis" is often used loosely as a synonym for cryptorchism.

Cryptorchism is an infrequent anomaly. Eccles [1] reports 854 cases among 48,000 men with hernia, Coley,[2] 737 among 59,235. Marshall found 11 cases among 10,800 recruits.

Retention.—By obstruction to its progress or by traction from behind (peritoneal adhesions) the testis may be retained inside the abdomen, or it may be arrested at any point in its descent. Hence there may be: (1) *Abdominal retention,* the testis lying in the lumbar region, or floating attached by a "mesorchium," or resting in the false pelvis near the internal abdominal ring (iliac retention). (2) *Inguinal retention,* the most common variety, the testis lying in the inguinal canal. (3) *Puboscrotal retention,* the testis lying just under the pubic bone. (4) Rarely the testicle alone is retained, while the epididymis and vas are separated from it and descend normally into the scrotum.

The position of the retained organ is only relatively fixed. It has a certain range of motion, sometimes so great as to leave the classification doubtful. A severe strain may cause retraction into the inguinal canal of a testicle that had been supposed to be normal.

Ectopia.—Abnormal tension of some of the accessory bands of the gubernaculum may drag the testis out of its normal course: (1) into the perineum,[3] where it lies beneath the deep fascia, in front of the anus (among Coley's 737 cases only 15 were perineal); or (2) through the crural canal to the saphenous opening (very rare); or (3) into the opposite side of the scrotum (cases of Jordan [4] and von Lenhossek); or (4) to the front of the pubis at the base of the penis (2 cases of Popow [5]).

Inversion.—The testicle may be turned upside down in the scrotum, or rotated so that its long axis is horizontal or abnormally attached to the epididymis (cf. Jacobson). The only clinical significance of these very rare anomalies is their bearing on puncture of hydrocele, for the inverted testis may lie above and in front of instead of below and behind the tunica vaginalis.

Condition of the Testicle.—The retained testicle is likely to be small and its spermatogenetic function impaired. The interference

[1] *Lancet,* 1902, i, 569, 722.
[2] *Ann. Surg.,* 1908, xlviii, 321.
[3] Cf. Loewe, *Jour. A. M. A.,* 1915, lxv, No. 14.
[4] *Deutsch. med. Wochenschr.,* 1895, xxi, 525.
[5] *Bull. de la soc. anat.,* 1888, v, ii, 653.

with growth and function is proportionate to the pressure to which the testicle is subjected. Thus so long as the testicle is outside the inguinal canal its development is not likely to be very gravely interfered with.

The spermatogenetic function does develop, however, though a little late, in most of the testicles that do not show any definite deformity of epididymis or vas (and even in some of these). Examination of such an organ shortly after puberty will show the tunica albuginea and the interstitial tissue of the testicle abnormally developed while the parenchymatous cells are proportionately much more numerous than the spermatogenetic cells (Odiorne and Simmons).[1] After puberty the spermatogenetic function is soon lost; so soon indeed that Bland-Sutton [2] derides the surgeon's effort to save the retained testicle by replacing it in the scrotum.

Fortunately the growth of the interstitial cells is much less impeded than that of the spermatogenetic cells so that, as a rule, even abdominal retention of both testicles does not interfere with virile development.

A great majority of double cryptorchids are sterile, and so general is the application of this rule that Curling,[3] after citing several cases of women married to cryptorchids bearing one or several children, felt compelled to doubt the paternity. But several similar cases have been reported since, a notable one by Milner Smyth,[4] whose patient begot five children, and the question is seemingly closed by the observations of Beigel [5] and of Valette.[6] The former found numerous spermatozoa in the semen of a double cryptorchid aged twenty-two. The latter found a few in the retained testicle removed from a man twenty-one years old.

In determining the sterility of any given patient several points must be taken into consideration.

1. The position of the testicles, since all abdominal cryptorchids appear to be sterile.

2. Freedom from previous or present inflammation.

3. The size, consistence, sensitiveness, motility and abnormality of the testicle, and

4. The age of the patient. All the cryptorchids to whom children have been attributed were young men. The period of possible paternity is apparently not over five or ten years.

[1] *Annals of Surgery,* December, 1904.
[2] *Practitioner,* January, 1910.
[3] *Op. cit.,* p. 467.
[4] *Lancet,* 1899, ii, 785.
[5] *Virchow's Archiv.,* 1867, xxxviii, 144.
[6] *Lyon med.,* 1869, ii, 20. Cf. also Schmidt, *Beitr. z. klin. Chir.,* 1912, lxxxii, 36.

5. A definite conclusion is impossible, except from the microscopical examination of the semen for spermatozoa.

Complications of Cryptorchism.—*Pain* in the testicle is an early evidence that the surrounding muscles are exerting injurious pressure upon the gland. *Inflammation,* whether traumatic or gonorrheal, is not rare, and, if acute, is exquisitely painful. *Atrophy* follows. Hydrocele, gangrene, abscess, and fatal peritonitis are among the rarer consequences of inflammation.

Hernia, actual or potential, always accompanies inguinal retention, since the testicle keeps the canal patent. *Torsion of the cord* occurs almost exclusively in malposed testicles.

Malignant growths affect the retained as they do the descended testicle (p. 594). The tradition that the retained testis is peculiarly liable to cancer was first disputed by Eccles. With this opinion subsequent authors do not concur. Buckley[1] states that:

About one in four cases of malignant abnormally situated testicles is found within the abdomen; one malignant abdominal testicle occurs to each 15 malignant scrotal testicles; about one in each 75 abdominally retained testes will become malignant.

Cases occur mainly during the years of greatest sexual activity; they may occur in apparent females, and are slightly more frequent on the right side.

The structure of the tumors differs markedly, but most of them are probably teratomata.

Symptoms do not occur until the size of the tumor or its metastases cause pressure.

The prognosis is bad. Of 50 cases reported only 3 are known to be alive and well after two years.

Prognosis.—Spontaneous descent of the testicle may not be looked for after the first year in any large proportion of cases. A sudden muscular effort caused spontaneous descent of the testicles of a man thirty-three years old (Landouzy), but this is a most exceptional case. Ambrose Paré has left an amusing account of one Marie Germain who jumped a ditch in chasing her pigs when, feeling a sharp pain and "seeing her genitals develop," *"s'en retourne larmoyante en la maison de sa mère disant que ses tripes lui estoient sorties hors du ventre,"* whereupon her true sex was recognized and she became a man.

In general the prognosis of retained testis is "atrophy, perhaps sarcoma."

Treatment.—During infancy every effort should be made by pad and truss to encourage the testicle to descend. Success is possible up to the tenth year. Armstrong[2] alleges that in three out of four boys 13 years of age in whom no testicles could be felt the administration of

[1] *Surg., Gynec. and Obstet.,* 1913, xxii, 704.

[2] *Med. Press and Circ.,* Aug. 4, 1915.

thyroid extract led to the descent of these glands into the scrotum within three months.

If such treatment does not effect reduction, the testicle may be allowed to remain where it is, or operation may be performed to drag it down or to extirpate it. If there is pain or hernia, this attempt should certainly be made and the testicle sacrificed if it cannot be brought down. Broca [1] has succeeded in bringing down 138 such testicles without a death. Of 79 cases observed for over a year 31 had apparently normal testicles, 35 had testicles normal in quality, but abnormal in position (near the external ring), while in only 13 had the gland atrophied. In 1 case the abdominal wall remained weak, and in no case was there any recurrence of pain. Only once was castration required.

"The operation should not be attempted before the eighth year nor delayed beyond the twelfth" (Coley [2]).

When this operation fails, castration is, in most instances, preferable to abdominal reposition, which subjects the gland to the very dangers (except hernia) to be avoided.

[1] *Gaz. Hebdom.*, 1899, iv, 289, and *Gaz. des hôp.*, 1899, lxxii, 315.

[2] *Ann. of Surg.*, 1908, xlviii, 321.

CHAPTER LIX

INFLAMMATIONS OF THE TESTICLE AND EPIDIDYMIS

Inflammation of the testicle may be limited to the epididymis (epididymitis), or may attack the secreting structure only (orchitis). The secreting structure may become secondarily involved by a simple inflammation commencing in the epididymis, but the latter rarely suffers as a result of orchitis. The tunica vaginalis, lying close to the epididymis, becomes inflamed in most cases of epididymitis, constituting acute hydrocele. On the other hand, hydrocele is rare with orchitis, since the dense tunica albuginea prevents an inflammation originating on one side of it from being readily transmitted to the other.

Etiology.—Inflammations of the testicle may arise by:

1. Infection passing along the seminal canals from the urethra.
2. Infection from the blood or the lymph.
3. Trauma.

1. To the first class belong simple inflammatory and gonorrheal infections; they involve the epididymis only. Tuberculosis probably belongs here (though it attacks the testis secondarily).

2. To the second class belong syphilitic inflammations (usually beginning in the testicle) and the orchitis of infectious diseases.

3. Inflammations of the third class (traumatic) implicate both testis and epididymis, but chiefly the former.

EPIDIDYMITIS

Epididymitis is the most common of all the diseases of the testicle. It occurs at any age, most frequently during early adult life and middle age, since its chief cause—urethral inflammation or irritation—exists most commonly during these periods of life. It is usually acute, but may be subacute from the first. It habitually terminates in resolution, rarely in abscess. One attack predisposes to another. It is often double, but the inflammation of one testicle usually precedes that of the other. Relapse is not uncommon.

ETIOLOGY

The prime cause of epididymitis is inflammation of the *posterior* urethra. The inflammation travels from the urethra up the ejaculatory

duct and along the vas deferens by extension of the inflammation along the lymphatics of these canals. This explanation has been disputed, but three facts prove it:

1. No matter what the condition of the anterior urethra, epididymitis never occurs except from inflammation or trauma of the posterior urethra.

2. The prodromal symptoms often point to inflammation of the vas before there is inflammation of the epididymis.

3. Vasotomy[1] has, in my experience, cured the most inveterate cases of relapsing epididymitis.

Gonorrhea.—Epididymitis is to be looked for mainly from the third to the eighth week of gonorrhea. A number of cases are on record in which it is alleged that epididymitis has preceded the gonorrheal outbreak (Fourneaux-Jordan, Sturgis, Stansbury, Castelnau, Vidal). Such an occurrence can only be explained by the existence of antecedent posterior urethritis or spermatocystitis.

Some individuals seem predisposed to epididymitis, so that, notwithstanding the utmost care, every attack of gonorrhea is invariably attended by swelled testicles; while others, regardless of all hygienic precautions, go about with a raging gonorrhea, employing no treatment, continuing sexual intercourse and the abuse of alcohol, not even supporting the testicles, and yet escape. Indeed, the one patient who took more scrupulous care of himself than any other in my whole experience, who went to bed and stayed there, took no local treatment whatever, and lived on the lightest of diets, in due time developed a double epididymitis, which terminated in suppuration on both sides.

It may, however, be stated dogmatically that while a gonorrhea of itself will sometimes, in spite of all precautions, occasion swelled testicles, yet this complication is not likely to ensue if the patient wear a suspensory bandage, abstain from violent or jolting exercise (horseback riding, dancing), sexual excitement and the use of alcohol. The passage of instruments through a canal subject at the time to gonorrhea is a sufficient cause for epididymitis. The local, and especially the abortive, methods of treatment are, therefore, peculiarly liable to occasion swelled testicle. Yet the modern, moderate local treatment, if promptly applied and properly administered, is the one way to prevent posterior urethritis, epididymitis, and all the other complications of gonorrhea.

Non-gonorrheal Infection.—The peculiar characteristics of non-gonorrheal epididymitis occurring in the course of stricture and prostatism have long been recognized. Two other facts have escaped notice however. In the first place, epididymitis may occur in the absence of gonorrhea or of any urethral obstruction. It is due to infection of the seminal vesicle and exhibits certain striking differences from gon-

[1] Cf. Chetwood, *Jour. of. Cut. and Gen.-Urin. Diseases,* 1900, xviii, 445.

orrheal epididymitis. Furthermore, epididymitis occurring in the course of a gonorrhea but similar in type to this non-gonorrheal infection is usually not due to the gonococcus.

The bacterial cause is usually a staphylococcus, rarely a streptococcus, B. coli, B. lactis aërogenes, etc. Smears and cultures are often negative.

PATHOLOGY

Gonorrheal Infection.—Typical gonorrheal epididymitis begins in the globus minor as an acute inflammation that always proceeds to the formation of pus, but the pus foci, though multiple, rarely contain more than a few drops of pus. If mild the infection remains confined to this end of the epididymis. If severe it may extend throughout the organ, producing similar miliary abscesses at various points, while the whole epididymis becomes infiltrated, swollen and red. *The testicle takes no part in the inflammation,* but the tunica vaginalis may be acutely inflamed, and hydrocele may result. The hyperacute case combines an intensely swollen epididymis, an acute hydrocele, and considerable edema of the cellular tissue about the testicle so that this feels like an evenly swollen hard sensitive mass. The vas deferens may share in a severe inflammation to the extent of a sensitiveness and slight thickening; but the deferentitis does not show the virulence characteristic of non-gonorrheal infection.

Non-gonorrheal Infection.—Infection with bacteria other than the gonococcus may occur during a gonorrhea. Indeed inasmuch as smears and cultures are often negative it is difficult to distinguish the limitations of the two types of inflammation. The typical non-gonorrheal case follows one of two types:

1. The pseudotuberculous type. The inflammation begins, often in a patient with no history of antecedent urethral lesion, as a chronic inflammatory nodule in the globus minor, but slightly tender and causing no constitutional disturbance. It passes for tuberculosis until, quite spontaneously, it disappears, leaving a scarcely perceptible thickening of the epididymis.

2. The inflammation begins, not in the epididymis at all, but in the seminal vesicle and vas deferens. There may be stricture, prostatism, chronic posterior urethritis or the infection may begin independently of any known preceding lesion. At the outset the vesicle becomes, not only large, but thickened and finally of a wooden hardness and much thickened. There may be abscesses in the vesicle or in the adjacent prostatic lateral lobe, but these are uncommon; the vesicle usually feels about the size of the little finger, and is not very sensitive. From the vesicle, the inflammation advances along the vas as a perideferentitis, the whole cord becomes thick, sensitive, adherent.

It usually reaches the size of a lead pencil and may be twice as large. The progress of the inflammation may sometimes be followed day by day as it advances down the vas toward the epididymis.[1] The tendency of this infection is to result in abscess either in the epididymis or at the external abdominal ring.

The Decline.—The gonorrheal and non-gonorrheal infections differ very markedly in their decline. The former, however acute, and although they always lead to miliary abscesses in the epididymis, very rarely terminate in gross suppuration. Expectant treatment will, almost always, promptly cure them. Within a few weeks the major part of the edema is absorbed, and there remains only a knot of scar at a point where the suppuration has been.

But the termination of non-gonococcic infection is much more grave. Fortunately abscess within the pelvis is rare. But abscess of the vas in the upper part of the scrotum, and abscess in the globus minor of the epididymis, are both common terminations. If gross suppuration does not occur the infection may hang on for an indefinite period, and if it finally does terminate without suppuration relapses are extremely common as compared to their infrequency in truly gonorrheal infection (unless the patient acquires a new gonorrhea).

Rare Types of Infection.—I have once seen a truly fulminating epididymitis. Operation revealed miliary abscesses throughout the epididymis, and resulting gangrene of the testicle requiring orchidectomy. B. coli was revealed by culture.

Barney [2] has reported cases of spontaneous abscess of the testicle without evidence of primary epididymitis. He obtained by culture the colon bacillus, a streptococcus and the B. mucosae capsulatus.

Ombrédanne [3] reports several cases of primary suppuration in the testicle in children which he attributes usually to torsion.

SYMPTOMS

Gonorrheal.—Usually the urethral discharge is not visibly modified until after the testicle begins to swell. Then it diminishes, perhaps stops, to return again as soon as the inflammation of the epididymis is fairly on the decline.

A vague uneasiness is sometimes felt in the testicle and along the cord up into the back, as if the cord were being pulled upon. Attentive patients will frequently aver that the pain was noticeable in the groin for some hours before any uneasiness was experienced in the testicle.

[1] The opposite course is also very frequently seen, the epididymis being involved first, and the cord being much thickened secondarily. We do not yet know whether this secondary deferentitis is usually gonorrheal or usually non-gonorrheal.

[2] *Surg., Gyn. & Obstet.*, March, 1914, 307.

[3] *Presse méd.*, 1913, xxi, 595.

The attack then begins with pain and swelling of the epididymis. In the *subacute* form, the swelling is moderate, comes on rather slowly, and is confined to the epididymis. There is but little, if any, fluid in the tunica vaginalis. There are no constitutional symptoms and the pain is not excruciating. It is aggravated by the erect posture, but wholly disappears when the patient is put on his back with the testicle elevated.

But the picture is a different one if the onset is *acute*. The swelling commences promptly and increases with rapidity. Within a few hours the testicle is swallowed up in the exquisite tension and tenderness of hyperacute epididymitis and vaginalitis. The scrotal tissues become edematous. The inflamed mass rapidly reaches the size of the fist. The cord may or may not share in the infection.

Non-gonorrheal.—One must distinguish the case in which the epididymitis predominates from that in which the deferentitis predominates. The former, if acute, resembles gonorrheal epididymitis but usually terminates in gross suppuration resulting in an abscess which fills the scrotum. These cases should be operated upon just as soon as it is evident that palliative treatment is not going to control them.

The subacute cases of the epididymal type usually simulate tuberculosis of the epididymis very closely. The patient has no gonorrhea, and there is often no very grave lesion in the prostate or seminal vesicles, though these organs contain pus. It is likely after a few weeks to recede spontaneously and leave but a very small scar to mark its passage.

The type of epididymitis in which inflammation of the vas predominates is described above.

Chronic and Relapsing Epididymitis.—Any of the acute types of epididymitis described above may dwindle off gradually into a chronic condition, usually with an irregular tendency to relapse. The relapses may occur in an epididymis which is constantly a little full and tender or after the original inflammation has apparently subsided. Gonococcic epididymitis is only likely to relapse if a new infection of gonorrhea occurs; indeed, unlike gonorrheal rheumatism, many a person has an epididymitis during one attack of gonorrhea, and none during subsequent attacks. But non-gonorrheal epididymitis is peculiarly subject to relapses without rhyme or reason in some instances. Relapses are habitually milder, but more long drawn out than the first attack. The only relief for such cases is drainage of the suppurating focus and division of the vas.

DIAGNOSIS

The diagnosis between the gonococcic, the non-gonococcic and the tuberculous epididymitis is by no means always easy until the condi-

tion has existed for some time. Tuberculosis is essentially chronic, progressive and associated with lesions in the internal genitals which, sooner or later, reveal their tuberculous nature. The only way to distinguish the non-gonococcic pseudotuberculosis of the epididymis in certain cases is to await the progress of the disease. If it is not due to tuberculosis it will disappear spontaneously. The deferentitis type is often mistaken for tuberculosis simply because its frequency and characteristic signs are not generally recognized.[1]

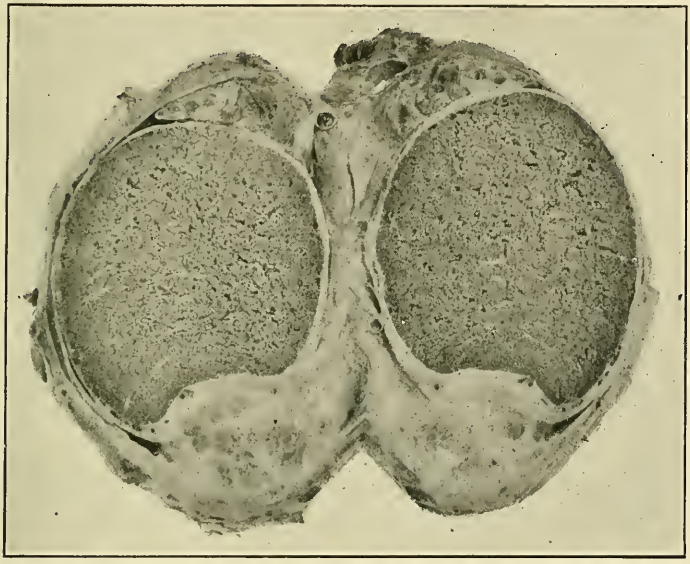


Fig. 120.—Abscess in Tail of Epididymis; Relapsing Epididymitis.

A positive complement fixation test for gonorrhea does not prove that an epididymitis is wholly due to the gonococcus; the possibility of error is indeed a small one, yet I fancy that certain cases, occurring during a gonorrhea, and with a complement fixation test positive, are due to a mixed infection and that this accounts for the certain cases of marked deferentitis and of suppuration following a gonorrheal epididymitis.

Acute orchitis is distinguished by its etiology, the more marked general symptoms, and the fact that the testis proper, and not the epididymis, is chiefly involved.

PROGNOSIS

As the disease advances, pain increases in intensity. The duration of pain and swelling depend almost exclusively on the treatment. This

[1] I have once seen a true tuberculosis of the deferential type.

should control fever and pain immediately. The swelling subsides more slowly.

The gradual disappearance of the hardness from the epididymis may extend over many months, and in most cases is never entirely accomplished. The point first attacked is the last to resolve. The absorption starts rapidly, but progresses more and more slowly, until it seems to remain stationary. The little hard lump in the epididymis occasions the patient no uneasiness, is not sensitive to pressure, and is ignored. Extensive *suppuration* is rare in gonorrheal epididymitis, but not uncommon in severe cases due to other bacteria. *Atrophy of the testicle* never results.

The prognosis may be summed up thus: there is no danger to life, to sexual potency, or to desire. Neuralgia or tuberculosis may follow acute epididymitis in subjects predisposed to these ills. Sterility (of the affected organ) and relapse are both possible results, but the former is not inevitable; the latter is uncommon.

Yet the patient is not impotent, his sexual power and appetite are unimpaired. He ejaculates semen resembling the healthy fluid in quantity, smell, and color, but containing no spermatozoa.

Benzler's [1] investigations are interesting in this regard. By looking up the subsequent history of old soldiers who had had gonorrhea while in the German army, he found that among those who had been married three or more years, 10.5 per cent of those who had suffered gonorrhea without epididymitis were childless, against 23.4 per cent of those who had had single epididymitis and 41.7 per cent of those who had had both organs inflamed.

Non-gonococcic epididymitis shows much more tendency to relapse and doubtless through its suppuration results more frequently in sterility of the testicle involved. But it is so rarely bilateral that the patient does not realize his defect.

On the other hand, traumatic epididymitis is far less likely than urethral epididymitis to lead to sterility, since the traumatic inflammation concerns the testicle and the surrounding tissue rather than the lumen of the canals. Thus Liégeois (Jacobson) found spermatozoa in the semen of only 7 out of 28 patients who had had double epididymitis, and of these, 5 cases were due to "local causes." Orchitis does not cause sterility unless the testicles atrophy.

TREATMENT OF EPIDIDYMITIS

Prophylaxis.—The prevention of epididymitis during the treatment of an inflamed urethra is compassed by means of gentleness. It is impossible to lay down a fixed rule by which this complication may

[1] *Archiv f. Derm. u. Syph.*, 1898, xlv, 33.

always be avoided. Even the rough passage of sounds through an inflamed urethra does not always cause it, while it may be excited by the gentlest of injections.

It is evident that inflammation invades the epididymis when a focus in the prostate or vesicle is lighted up by the trauma of urethral treatment. Yet the presence of this focus cannot always be ascertained, and, inasmuch as the complication sometimes arises when no urethral treatment is being employed, one cannot but feel a certain fatality in the matter. All that can be done is to exercise the greatest possible gentleness, especially in the introduction of dilating and metal instruments.

During acute gonorrhea it is customary to instruct the patient to wear a suspensory bandage, and this measure certainly reduces the danger of epididymitis, though it does not entirely prevent it.

Treatment of Gonorrheal Epididymitis.—The treatment consists of rest in bed, elevation of the testicle, applications to the testicle, and general medication.

Rest in Bed.—Although the mildest cases do not always require rest, one can never be sure when the first symptom of epididymitis appears whether the case will remain mild or whether, starting mildly, it will not go on by progressive extension to a prolonged or acute inflammation. Whenever this is possible, rest in bed is therefore required.

Elevation of the Testicle.—*Proper elevation of the testicle constitutes almost the sum of the treatment of acute epididymitis.* Simple as this statement seems, it is no easy matter to carry it into practice, for proper elevation of the testicle is very hard to achieve. Relatively good elevation may be achieved by a great variety of devices, among which one of the simplest is the ordinary jock-strap or suspensory bandage supplemented by a roll of gauze, the center of which is pinned underneath the testicle while its ends are brought around each groin, and then around the back, and tied in front of the belly. The tightening and loosening of this bandage, according to the patient's needs, often supplies excellent support especially for stout people. Adhesive plaster I do not care for during the acute stages of the disease.

If the patient is thoroughly under control in a hospital, or under the care of a nurse who understands its management, the bandage devised by the late Dr. Samuel Alexander is far superior to any I know. For four years I have employed it in Bellevue Hospital with entire success in all cases where the vas was not involved, and the condition did not go on to suppuration. The great majority of gonorrheal cases, in other words, yielded to this treatment immediately. On succeeding Dr. Alexander I found, and continued, the rule that no matter what the patient's condition when he entered the ward, his temperature

should drop to normal within forty-eight hours of the time the bandage was applied; he should be up and about for one or two days more and home on the fifth day. Any patient not fulfilling this routine either has his bandage badly applied, or a deferentitis, or a probability of suppuration.

The bandage consists of two parts: (1) A Canton flannel belt, four inches wide, is pinned about the abdomen. (2) A T-bandage made from the ordinary roll of gauze about three feet in length to the center of which is sewn the ends of two strips of Canton flannel about four feet long each. To the point of juncture of the Canton flannel and the roll of gauze a pad of gauze is pinned. This pad is usually made two inches long, one inch wide, and about a quarter of an inch thick, but its size must be varied in different cases. After the Canton flannel belt has been snugly pinned about the patient's middle, the T-bandage is so applied that the pad of gauze rests immediately beneath the patient's testicles, the two Canton flannel streamers extend around the gluteal curve and are pinned to the sides of the belt, while the two ends of the gauze roll are brought up on each side of the groin encircling the testicles and penis. Their lower edges are overlapped above the penis very snugly so that they form the neck of a sack from which the testicles cannot slip (thanks to the little pad) no matter how hard the traction upward over the abdomen. The ends of the gauze roll above this pin are now folded over each other to make a broad, flat band upon which traction is made, whereby the testicles are pulled up literally onto the pubes.

If the bandage is properly adjusted, and there is no inflammation of the vas deferens, the discomfort caused to the most exquisitely sensitive testicle is unimportant, and as soon as the bandage has been pinned well up on the belly band, this discomfort disappears, and is replaced by a sense of great relief. A piece of gauze is then loosely pinned across the front of the scrotum in order that when the patient rolls around in bed his testicles may not slip from the bandage. But great care must be taken to pin this cloth very loosely so as not to force the testicles back, since the whole object of the bandage is to force them forward.

If the vas deferens is already involved, even though it be only tender, one has to modify the bandage to the extent of easing up on the edge of that side so as not to press too tight in the groin.

If the patient is not well in three or four days after the application of this bandage, it is usually wise to operate; otherwise the inflammation will be a tedious one, very possibly complicated by suppuration, and almost certainly by considerable inflammation of the vas deferens.

The patient may get out of bed twenty-four hours after the temperature has become normal if the attack has been a brief one, forty-eight hours after if it has been prolonged. The above-described bandage

should then be discarded in favor of a jock-strap or an adhesive plaster dressing. The latter consists of strips of plaster some two inches broad running from the perineum on to the abdomen, first on one side and then on the other, lifting the testicles up as high as possible. This, or the jock-strap, should be worn for at least a week. Then if a considerable degree of swelling still remains in the epididymis this may be reduced by strapping as described below. This strapping has been dignified by the title of "Beer's compression."

If the case has been properly treated it usually subsides so quickly that no strapping is required but the patient discards his jock-strap for an ordinary suspensory which he wears for three or four weeks.

Local Applications.—Poultices are light and soothing; there seems to be no particular virtue in the once-lauded tobacco poultice. Tucker's saturated solution of magnesium sulphate applied on several layers of gauze and covered with rubber tissue probably acts as a negative poultice. Guaiacol, one part, in glycerin, ten parts, is an admirable counterirritant for mild chronic epididymitis. I have discarded guaiacol in the treatment of acute infections. Hot water bags are heavy. To most patients the application of cold, in the form of an ice pack, is more grateful than heat, but if the bandage above described is properly applied, no further relief of pain is usually required.

General Treatment.—Apart from a light diet and rest in bed, specific drugs, such as aconite and vaccines, have fallen into merited disfavor.

Operative Treatment.—Hagner justly claims for his operation the immediate relief of pain, but the convalescence from the operation requires longer than that from the use of the bandage described above, and we reserve operative treatment for those upon whom this elevation fails.

The claim that operation reduces the prospect of sterility after epididymitis is not supported by any very large statistics and is, perhaps, not well founded. A similar claim has been made for the Beer treatment by compression with a rubber bandage.

Strapping.—The strapping should be done so as to produce the maximum of pressure with the minimum of discomfort, and at no time should the testicle, which remains tender, be squeezed tightly enough to produce any lasting uneasiness. The method of strapping the testicle which I now employ is far superior to the old way with overlying strips of adhesive plaster. It was devised by Dr. Chetwood.

A piece of tape is first tied rather snugly about the base of the scrotum to hold the inflamed testicle down and its fellow up out of the way. A strip of light rubber (Martin) bandage, 15 or 20 cm. long

and 10 cm. wide, and a piece of adhesive plaster, 1 cm. wide and 10 cm. long, constitute the apparatus.

The adhesive plaster is stuck to one end of the bandage as shown in Fig. 121. The scrotum is gently lifted and the uninflamed testicle pushed up out of the way. The inflamed organ is then encircled with the rubber bandage as tightly as the patient can bear it (this is a matter of experience), and as the bandage is wrapped in place the adhesive

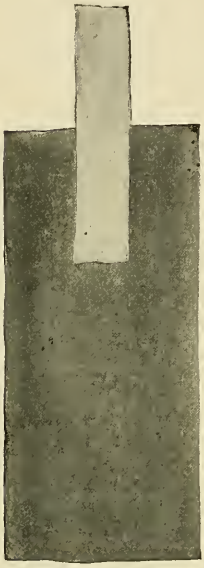


Fig. 121.—Rubber Bandage for Strapping.

Fig. 122.—The Bandage Applied.

plaster is brought around, and holds it fast (Fig. 122). Absolutely the only precaution necessary is to get the line of greatest pressure above the line of greatest swelling—i. e., to make the adhesive plaster encircle the organ above its equator, for otherwise it will promptly slip off. The advantages of this bandage need not be enumerated, but the chief one is that it may be removed daily to be put on more tightly. This it is expedient to do.

The Urethra.—Last, but not least, *no local treatment to the urethra* should be attempted during or after an attack of epididymitis. It will only harm the testicle without helping the canal. The length of time that must elapse before the urethra is again treated locally varies. For most patients two weeks suffice.

Recurrent Epididymitis.—Each attack of recurrent epididymitis may be treated by the measures detailed above; but between times preventive measures must be instituted to ward off future attacks. This

prophylactic treatment may be directed toward the general health, the seminal vesicle, and the testicle itself.

A strict hygiene, sexual and general, is essential in every case. Aided by tonics, milk, fats, etc. (with perhaps a vacation), this alone may effect a cure.

The treatment of the posterior urethra depends upon its tolerance. If it will bear instrumentation, instillations, irrigations, and massage help; but in a certain proportion of cases such attempts only serve to stir up the testicle and make the patient worse. The hot rectal douche is here peculiarly applicable, since it is absolutely harmless.

The testicle itself should always be supported. I have known a man who could not for three months leave off a towel T-bandage which slung his testicles over his abdomen. No lesser support would prevent a recurrence of the attacks. Yet he is now permanently well.

If all these palliative measures fail, there is but one alternative. The patient must either get along with his testicle as well as he may, or submit to vasotomy with puncture and drainage of the focus in the epididymis. I hesitate to advocate this operation. But, on the other hand, in every case put to the test, the effect has been immediate, absolute, and permanent. Not one died, not one relapsed, not one but was intensely gratified with the operation. I have watched one case for four years, others for a less time. This, at least, can be said of it: that the operation itself is quite insignificant, and that, like epididymitis, it never causes impotence, loss of desire, or atrophy of the testicle.

ORCHITIS

Secondary orchitis—orchitis complicating epididymitis—is very rare. Primary orchitis—orchitis due to traumatism or to systemic disease—is also rare. Exceptionally orchitis occurs without discoverable cause.

VARIETIES

Several types of orchitis may be distinguished:

1. Traumatic orchitis.

2. Metastatic orchitis. We are chiefly concerned with this form of the disease. It is a common complication of mumps, and has occasionally been met with during typhoid fever,[1] influenza, small-pox, tonsillitis, and rheumatism.[2] The orchitis of mumps is a type of these.

Traumatic Orchitis.—Severe contusion, commonly a kick or a blow inflicted by a missile, causes an acute inflammation of the testis and epididymis, which, though usually short-lived, may terminate in

[1] Cf. Kinnicutt, *Med. Record*, 1901, lix, 801.

[2] *Guyon's Annales*, 1894, xii, 306.

atrophy of the testis, abscess, or gangrene. Lesser bruises or strains cause an inflammation which habitually terminates in resolution only. Yet atrophy may follow a slight injury.

Orchitis from strain has been attributed to spasm of the cremaster and to compression of the cord by the abdominal muscles (Velpeau). It may perhaps be due to slight torsion.

Orchitis of Mumps.—The orchitis of mumps is most frequent at about puberty. It is almost unknown in childhood. It comes on near the end of the first week of mumps, and is usually confined to a single testicle. The testicle may, however, become inflamed before the parotid, and the mumps may even be confined to the testicle. Orchitis occurs in at least 5 per cent of cases of mumps in young adults. Indeed, Laveran[1] met with 156 cases of orchitis among 432 cases of mumps occurring in soldiers. The epididymis may or may not be involved. The affection runs a quick course of about a week or ten days, very rarely terminates in suppuration, may subside without leaving behind any impairment of the organ, but is often followed by atrophy. This occurred in 73 of Laveran's cases. Abscess and gangrene are very rare.

SYMPTOMS

Local Symptoms.—The testis increases slowly in size, and seldom becomes very large. This is due to the unyielding nature of the albuginea, and to the fact that there is usually no effusion into the tunica vaginalis. The pain, which is often excruciating, and always out of proportion to the amount of swelling, is due to the tension of the albuginea. This pain has been compared to that of nephritic or hepatic colic. No position gives rest, and any handling of the organ may induce syncope. The pain continues severe for several days, and then gradually becomes more bearable, or it may suddenly cease altogether. This last circumstance is gratifying to the patient only, for it may mean gangrene of the organ.

The shape of the testicle is rarely altered in orchitis; it is smoothly, regularly ovoid. The epididymis is not distinguishable from the rest of the tumor. The scrotal tissues are often red, swollen, edematous, inflamed.

General Symptoms.—*The general symptoms* in true orchitis are marked, often severe: chills, high fever, vomiting, hiccough, sleeplessness, etc. These symptoms have been compared to those of strangulated hernia. Indeed, there is more or less strangulation of the testicle within its tight, fibrous sheath.

Termination.—The disease usually terminates by resolution. The testicle may then remain normal or it may go on to *atrophy,* this process

[1] *Med. Times and Gazette,* vi, July 20, 1878.

requiring several weeks, at the end of which time nothing is left of the testicle but a small, insensitive mass. *Abscess* is a rare termination and gangrene still more rare.

TREATMENT

Treatment.—It is stated that the orchitis of mumps does not occur if the patient is kept in bed for eight days. Such a precaution is therefore a wise one for all young adults, though they cannot always be made to comply with it. The testicles should also be kept supported.

After the attack has once begun the patient needs no urging to keep him in bed. Ice may relieve pain. If the symptoms fail to abate it is wise to resort without delay to subcutaneous section of the tunica albuginea in order to take off tension from the strangulated parts within. This simple operation is readily performed with a sharp tenotomy knife introduced through the skin, and then made to cut the tense fibrous capsule, while the testicle is steadied in the other hand. The incision should be carried fairly through the tunica albuginea, three to six short cuts 5 to 10 cm. long being made at different points on the surface of the testicle. The pain will usually cease after the tension has been relieved. Abscess requires drainage, gangrene castration.

Fistulae are treated *secundum artem;* drained, curetted, and cupped. A thoroughly disorganized fistulous testicle had best be removed.

CHAPTER LX

TUBERCULOSIS OF THE EPIDIDYMIS

Tuberculosis affects the testicle in two ways:

1. Diffuse miliary tuberculosis, associated with general miliary tuberculosis, and of no interest to the surgeon.

2. Circumscribed tuberculosis, which concerns us here. This form of tubercle appears as localized deposits, one or more, beginning in the epididymis, and involving the testicle only secondarily.

ETIOLOGY

Pathogenesis.—There are three theories concerning the genesis of genital tuberculosis:

1. That it is primary in the prostate or the seminal vesicles whence the epididymis is invaded secondarily, the inflammation extending along the vas, or, possibly, by way of the lymphatics (Kocher,[1] Lanceraux,[2] Guyon,[3] Simmonds,[4] Walker [5]).

2. That genital tuberculosis is primary in the epididymis, secondary in the prostate and seminal vesicles (Réclus,[6] Senn,[7] Councilman,[8] Barney [9]).

3. That the tuberculosis, whether occurring primarily in the one end of the seminal canals or in the other, may be due to inoculation during coitus (Verneuil, Jacobson,[10] Paladino-Blandini [11]).

Two questions, therefore, arise: Can the inoculation take place during coitus? Is the epididymis invaded primarily or secondarily?

As to infection during coitus, no one holds that such infection is at

[1] *Op. cit.*, p. 326.
[2] *Guyon's Annales*, 1883, i, 153.
[3] *Ibid.*, 1891, ix, 445.
[4] *Beitr. z. klin. d. Tbc.*, Nov., 1914, No. 1.
[5] *Lancet*, 1913, clxxxiv, 435.
[6] "Du tubercule du testicule," Paris, 1876.
[7] "Tuberculosis of the Gen.-Urin. Organs," 1897, p. 48.
[8] Dennis's "Surgery," 1895, i, 246.
[9] *Bost. Med. and Surg. Jour.*, July 3, 1913.
[10] *Op. cit.*, p. 323.
[11] *Guyon's Annales*, 1900, xviii, 1009.

all frequent. The question is whether or not it ever occurs. Tubercle bacilli have been found in the healthy epididymis (Jani and Weigert[1]), and Paladino-Blandini and T. Walker have apparently shown that bacteria, tubercle bacilli among others, when deposited on the mucous membrane of the urethra near the meatus may reach the epididymis, but cause no inflammation there under ordinary conditions. Yet these experiments prove only that infection in coitus is barely possible, for the combination of circumstances postulated—viz., a massive urethral inoculation and a trauma to the testicle—would be, clinically, hard to find. Inoculation *per urethram* is, to say the least, improbable.

Is the epididymis invaded primarily or secondarily? The highest authorities are divided on this point, and perhaps this division is founded on a diversity of cases, some primary, some secondary. There is no question here of the primary focus in the body, but only of the primary focus in the genital tract. Is it in the epididymis, or is it in the prostate and vesicle? I cannot answer the question except by an array of facts, all of which seem to point toward the same conclusion: (1) I have examined the urine of every case of tuberculous epididymis that I have seen in the last ten years, and in no case have I failed to find in the urine either shreds or pus (indicative of a prostatic congestion). (2) I have seen tuberculous prostatitis and vesiculitis without any lesion of the epididymis. (3) When, one epididymis being already involved, the other one becomes implicated, I am confident that tuberculous internal genitals form the bridge from one side to the other, and therefore the second epididymis, at least, is not involved primarily.

To sum up: With a tuberculous epididymis the prostate is never normal (though its congestion may possibly be similar to that seen about the mouth of the ureter in a tuberculous kidney) and is sometimes manifestly tuberculous to rectal touch. On the other hand, with a tuberculous prostate or vesicle the epididymis is not necessarily involved. Involvement of the prostate precedes involvement of the second testicle. The migration of the bacteria in sufficient numbers to cause damage is rendered intelligible by Paladino-Blandini's experiments, referred to above, which, while they do not reproduce the conditions requisite for infection in coitus, do represent with sufficient accuracy the conditions of so-called ascending inflammation. All the weight of this evidence goes to show that, in many, if not in all, cases, the prostate or vesicle is tuberculous before the epididymis becomes so. T. Walker believes that the urine from a tuberculous kidney usually is the source of the primal prostatic focus.

The supporters of the theory of primary epididymal tuberculosis insist upon the fact that biologically the epididymis is an excretory organ infected like the kidney from the blood stream.

[1] *Virchow's Archiv*, 1886, ciii, 522.

The *age* at which tuberculous inflammation is most common is between twenty and thirty. Fully half the cases occur between these years, and the disease is very rare before fifteen and after fifty. But a number of cases have been reported in infancy.[1]

PATHOLOGY

Authorities differ as to whether the epithelium or the intertubular tissues of the *epididymis* are first involved, and on these differences build a support to their views upon the primary and secondary nature of the disease. The first lesion is almost invariably found in the

Fig. 123.—Specimens Obtained by Orchidectomy and Epididymectomy for Tuberculosis. The epididymes (laterally) are tuberculous throughout; on right side was much enlarged; on left normal. Testis (center) split, showing tubercles.

globus minor of the epididymis. There it may remain localized, or it may spread by continuity throughout the epididymis and the testicle, or distinct foci may appear in the head of the epididymis. The tubercles conglomerate to form the hard masses so typical of tuberculosis. These go on usually to caseation, suppuration, and fistulization, or else cicatrize or calcify.

The Vas.—The vas is often lumpy with tuberculous deposits, and may be involved in a perideferentitis throughout its length. The *vesicle* and *prostate* may be clinically tuberculous.

The Testicle.—The testicle is often invaded by a tuberculoma or by an abscess. Primary tuberculosis of this organ does not occur. Yet testes obtained by castration often show a more or less widely dis-

[1] Cf. Viguard and Thevowot, *Ann. de méd. et chir. inf.*, 1911, xv, 561. Also Lyons, *Jour. A. M. A.*, 1913, lxi, 2051.

seminated beginning tuberculosis of this gland. This discovery has been hailed as startling proof of the advantage of total castration; it being very justly urged that the lesions in the testicles would be overlooked by the surgeon intent upon epididymectomy. It is true that these lesions of the testicles are often present in cases treated by

FIG. 124.—SECTION OF TUBERCULOUS TESTICLE. A group of tubercles invading the healthy tissue.

conservative operations, as well as in those not treated surgically. But the testicle is able to overcome the infection if given an opportunity by epididymectomy. Thus Barney[1] states that though the testicle is clinically tuberculous in 44 per cent of cases, there has been no local relapse after epididymectomy in "almost 100 cases."

The Vaginalis.—The tunica vaginalis may be studded with tubercles, producing chronic hydrocele. Operation always reveals hydrocele or adhesions within the vaginalis.

[1] *Boston Med. and Surg. Jour.*, 1913, clxviii, No. 25.

The Urinary Organs.—The urinary organs are often affected with the genital organs in at least one-third of all cases.

The Lungs.—The lungs are often enough spared. Thus Kocher, among 451 autopsies on cases of urogenital tuberculosis, found as many as 95 (21 per cent) with normal lungs. During life the pulmonary involvement is often insignificant. On the other hand, Réclus found, among 500 phthisical patients, 64 with genito-urinary tuberculosis, 45 with involvement of the genital tract, and 19 with tuberculous testes only.

SYMPTOMS

The patient, a young man,[1] comes complaining that one testicle is larger than the other. The swelling may have been spontaneous or it may have followed injury, or perhaps a previous gonorrheal epididymitis never got entirely well and began to swell again. Questioning may disclose a family or a personal history of tuberculosis, or an account of frequent and painful urination perhaps slight, previous, or still existing. The epididymal lesion is almost always tender, rarely painful.

Less often the onset is acute. The testicle is greatly swollen and hard. There is considerable pain, and the vaginalis rapidly fills. This condition may subside, leaving a few nodules here and there, or it may go on to suppuration.

Upon examining such a testicle it is usually found somewhat enlarged throughout, with large, hard nodules at one end or the other of the epididymis, or throughout its length. There may be lumps in the testicle itself. The outline may be obscured by fluid in the tunica vaginalis. The vas deferens may be knotty, enlarged, and hard, as far as it can be felt, and a finger in the rectum may detect the seminal vesicle similarly affected. Nodules may perhaps also be detected in the prostate; the urine contains shreds or free pus, and there are, perhaps, symptoms referable to tuberculosis of prostate, bladder, or kidney. The lungs, too, may be involved. Sexual power and desire are influenced only by the fears of the patient.

COURSE

The malady usually advances slowly, sometimes remaining stationary for many months. Finally, the nodules soften, the skin adheres,

[1] Goodman (*Med. Rec.*, 1914, lxxxv, 146) has collected 91 cases of tuberculosis of the testicle in children, half of them appearing in children less than two years old. The lesion usually suppurates and involves both the testicle and the epididymis. It therefore requires orchidectomy.

bursts and discharges a thick, cheesy material. The fistula persists indefinitely. But after many months it usually heals.

We occasionally meet with a case which starts like an ordinary acute epididymitis, the *tuberculose galopante du testicule* of Duplay, and never remits its fury. In other cases the chronic course of the disease is interrupted by acute exacerbations.

The cases [1] may be divided into two classes: (1) those in which the epididymal lesion is the chief active tuberculous lesion in the body (26 cases), and (2) those in which the tuberculous lesion is only a part—perhaps a relatively unimportant part—of genito-urinary (24 cases) or general (31 cases) tuberculosis; but no patient remains hard and fast in either class. The clinical picture varies as one or another lesion rises into prominence. One may follow clinically, however, and with some degree of order, the course of the lesion in the epididymis itself (where it may be acute or chronic, suppurating or quiescent) and in its fellow.

The acute onset, as well as the acute exacerbations during the course of the disease, are probably due to mixed infection. Caseation and fistula, however, occur without any mixed infection.

Such breaking down, whether acute or chronic, simple or tuberculous, occurred in at least 76 of the 152 testicles (probably in more). It is a striking fact, however, that of these 76 cases of softening or suppuration, 53 occurred in the first year, while late suppuration was noted only once in the third, fourth, and fifth years respectively.

It would seem, therefore, that if the process remains chronic in the epididymis for a year or two, it is not very likely to break down.

On the other hand, no suppuration occurred in 29 cases watched for more than one year. Fourteen of these were followed less than four years, 9 from four to nine years, and 6 respectively ten, eleven (2 cases), twelve (2 cases), and sixteen years.

Azoöspermia.—I have observed that a large proportion of these patients are sterile from the time the *first* testicle is involved. Barney states that 85 per cent of his patients were sterile. On the other hand, Fürbringer [2] alleges that tuberculosis of the epididymis is less likely to entail sterility than is gonorrhea.

Condition of the Opposite Testicle.—Here is perhaps the most important point of all. Many patients permit one testicle to be removed in the hope that the disease is confined to this one organ, and may be amputated. This hope is utterly vain, and relapse upon the opposite side frequently occurs, be the operation ever so slight or ever so radical.

This is proven by the summary of my 87 cases in which it is defi-

[1] This and some of the following paragraphs are quoted from my report of a hundred cases of tuberculous epididymitis in the *Annals of Surgery*, June, 1907.

[2] *Deutsche med. Wochenschr.*, 1913, xxxix, 1393.

nitely recorded that the opposite epididymis was or was not affected. Fifty-three so relapsed; 34 had not done so when last seen.

Involvement of the opposite epididymis occurred within the first two years in 46 cases. In only 3 did this occur after the third year, though 10 others remained unilateral for longer periods.

I have followed 69 cases for more than a year. Of the suppurating cases, 18 were still active when last seen. Sixteen either burst or were incised, suppurating for a certain number of months thereafter, and then were seemingly cured. Seven such apparent cures were followed from 3 to 10 years; 1 for 12 (bilateral); 1 for 13[1]; 1 for 25 (bilateral); 1 for 27 years. Yet, to prove that, no matter how long these patients remain well they are not absolutely guaranteed against relapse: in one case suppuration followed gonorrhea 14 years after the apparent healing.

Thus 15 per cent of cures, watched for more than three years followed suppuration. Yet, on the other hand, those cases which did not suppurate were forever smoldering or advancing. Single cases showed irregular activity as late as five, six, eight, and ten years after the onset; while apparent cures were observed at five, eight, nine, twelve,[1] and sixteen years—14 per cent.

Mortality.—I can record no mortality from tuberculous testicle. One patient died of phthisis, 2 of tuberculous meningitis, and 2 of pelvic abscess after operation; but none of these deaths is directly attributable to the testicle.

Barney reports that 41 per cent of 58 patients died within six years; half of them within a year of operation. Miliary, renal and lung tuberculosis were the usual fatal agencies.

DIAGNOSIS

The three conditions with which the tuberculous testicle is likely to be confused are simple epididymitis, syphilis, and neoplasm. The means for distinguishing the three are the following:

1. Aspiration of hydrocele or drainage of abscess in order that the lesions of testicle and epididymis may be accurately palpated.

2. Familiarity with the clinical aspect of tuberculosis of the testicle —the little round nodules; the diffuse infiltration of the epididymis; the acute epididymo-orchitis; the frequency of hydrocele and abscess; the ever-present sensitiveness to pressure.

3. Tuberculous family history and personal history.

4. Evidence of tuberculosis in the internal genital organs, such as active lesions or chronic tuberculous nodules.

[1] Opposite epididymes of one patient.

5. The diagnosis can be proven only by discovery of the tubercle bacillus in the urine, in the pus massaged from prostate, or in the contents of hydrocele fluid or abscess.

Early cases are especially obscure. If the lesion is in the epididymis and sensitive, it is not syphilis; it may be tuberculosis or simple epididymitis. In the absence of prostatic tuberculosis the diagnosis must be reserved for a few weeks. If the lesion is not tuberculous it will quite promptly suppurate or resolve.

TREATMENT

Hygienic Treatment.—The hygienic treatment of tuberculosis is the foundation of every cure.

Tuberculin Treatment.—As for renal tuberculosis.

Surgical Treatment.—It is bad surgical judgment not to remove the tuberculous epididymis unless other lesions greatly predominate or prohibit operation.

Epididymectomy removes only a small focus of tuberculosis; but it has the incalculable advantage of minimizing the lesions of prostate and vesicles that are not accessible to direct operation.

Vasectomy should be performed on the unaffected side if the semen contains no spermatozoa.

The testicle should be excised only when it is gravely diseased.

If radical operation is contra-indicated drainage, curettage and cupping of the epididymal lesion are called for unless the lesion is both small and quiescent.

CHAPTER LXI

DISEASES OF THE TESTICLE

LUXATION OF THE TESTICLE

P. Bruns [1] records the case of a man run over while lying on his back. The right testicle was dislocated over the pubis at the root of the penis. It remained there and did not atrophy. He refers to other traumatic dislocations, one under the skin of the thigh and a number into the inguinal canal.

HYPERTROPHY AND ATROPHY

Arrest of development is typical in the retained testis and may also affect the normally situated organ for no assignable cause.

True *atrophy* is caused by orchitis, by pressure (hydrocele, elephantiasis), by section or obstruction of the spermatic artery, by torsion, by trauma, by severe varicocele, and by injuries to the nerves, spinal cord, and brain. Sexual excess is alleged to have caused atrophy of the testicles. The physiological atrophy of old age has been studied by Desnos,[2] Griffith,[3] and Pawloff.[4]

There are two forms of atrophy, the one *sclerotic,* the result of inflammation, the other *fatty,* the result of an obstruction to the circulation.

The orchitis of mumps is the most frequent cause of atrophy of the testicle.

For atrophy of the testicle there is no treatment.

CONTUSIONS OF THE TESTICLE

Severe contusion of the testicle is rare, notwithstanding its exposed position. There is ecchymosis, and perhaps hematocele or orchitis;

[1] *Mittheilungen aus der chir. Klinik zu Tübingen,* 1884, iii, 483.
[2] *Guyon's Annales,* 1886, iv, 72.
[3] *Jour. of Anat. and Phys.,* 1893–94, xxviii, 209.
[4] *Guyon's Annales,* 1894, xii, 291.

atrophy may result. One of the modes formerly adopted in the East for emasculating the attendants of the harem was that of squeezing the testis. The inflammation after injury may be sufficiently severe to result in abscess or gangrene.

Kocher records 2 deaths from the shock of contusion of the testicles.

Treatment.—If the contusion be severe, the patient must be placed at once upon his back, with the testicle elevated and covered with an ice-cap; if subsequent inflammation occur, it must be met appropriately (p. 579).

WOUNDS OF THE TESTICLE

Punctured wounds, if small, are of no importance. Penetrating wounds of fair size, however, permit some of the tubular structure of the testis to escape. This is likely to be mistaken for a slough, and to be pulled out as such. Malgaigne mentions a case where the whole pulp of the organ was pulled out in this way. Injuries to the testicle, whether contusions or wounds, are exquisitely painful, and give rise to faintness, nausea, vomiting, and even convulsions. The testis may atrophy as the result of the injury or of a subsequent orchitis.

Treatment.—Hernia of the secreting substance should be reduced if possible, and retained by pressure, or by a suture through the tunica albuginea. If it cannot be reduced, it may be snipped off with the scissors, but should in no case be pulled upon.

GANGRENE OF THE TESTICLE

Torsion of the Spermatic Cord.—Gangrene of the testicle is commonly due to this cause. Scudder[1] has collected 31 cases, to which he adds 1 of his own. Of the 32 cases, 17 occurred on the right side, 11 on the left. Seventy-five per cent occurred in patients under twenty-three, at an age, namely, when the individual is most exposed to traumatism, and yet the trouble was usually attributed to nothing more violent than some indefinite strain. Indeed, in several cases the attacks were recurrent; thus, Van der Poel's patient learned that untwisting the testicle relieved the pain.

Etiology.—The only evident predisposing cause is malposition of the testicle. Ten times the affected gland was retained in the inguinal canal, 5 times close under the pubes. Hence it is inferred that a long mesorchium is required to permit torsion of the testis.

Pathology.—The pathological changes in the testicle are well

[1] *Annals of Surgery*, 1901, xxxiv, 234. Loefberg (*Hygiea*, 1911, lxxiii, No. 9) has collected 79 cases.

known from the results of castration. The testicle is found congested, hemorrhagic, edematous, or gangrenous. There is usually vaginal hydrocele or hematocele. The cord is found twisted upon itself (outward in 7 cases, inward in 5) one-half to two and one-half turns, and strangulated at the point of torsion.

Ombrédanne [1] attributes abscesses of the testicle in lads of from 10 to 15 to torsion. Among seven cases operated upon this condition was certainly present in four, probably in six.

Symptoms.—The symptoms are usually those of strangulated hernia. The groin and scrotum swell rapidly and become exquisitely sensitive. The patient vomits and is feverish and faint. Chill and syncope may occur. If the testicle is normally situated it may unroll spontaneously, thus relieving all the symptoms; this rarely happens.

It is probable that certain cases of acute spontaneous orchitis are due to slight or temporary torsion of the cord (Ombrédanne).

Diagnosis.—Torsion of the cord has been distinguished from strangulated hernia by the mildness of the systemic disturbance, after the first shock has passed, in contrast with the severity of the local symptoms. In case of doubt immediate operation solves the difficulty.

Treatment.—Recurrent torsion might be prevented by anchoring the testicle to the dartos.

In the emergency of an acute attack it may be possible to untwist the testicle, as was done by Nash an hour and a half after the onset of symptoms. (The testicle subsequently atrophied.) In the majority of cases, however, operation affords the only hope of relief. The operation has been performed 29 times with no deaths (Scudder). Once the testicle was allowed to slough away through a simple incision. The cord was untwisted 5 times. This was followed twice by sloughing and thrice by atrophy. Twenty-three castrations were successful.

Injury to the Spermatic Cord.—While such injuries to the spermatic cord as totally shut off the blood supply of the testicle are calculated to cause gangrene of the organ, the impunity with which the cord may be tied off is exemplified by numerous cases collected by Mauclaire. This operation is, apparently, almost always followed by simple atrophy of the testicle, for the blood supply to the testicle from the surrounding fascia furnishes sufficient nutrition to prevent gangrene.

IRRITABLE AND NEURALGIC TESTICLE

Irritability or neuralgia of the testicle consists in an abnormal sensitiveness of the whole gland or of some particular part of it. Mere contact of the clothing may be exquisitely painful. In the recumbent

[1] *Presse méd.*, 1913, xxi, 595.

posture with nothing in contact with the testicle, the pain usually disappears. In other cases the pain is constant, and perhaps quite mild, but increased by walking and standing so as to occasion great discomfort. The character of the pain is acute and darting, or heavy and dragging. The cremaster contracts spasmodically during severe paroxysms, forcibly retracting the testicle. Between paroxysms the testicle is often entirely free from pain. Handling the organ may perhaps induce a paroxysm. The testis, sometimes swollen and tense, is otherwise unaltered. There is no febrile reaction. Neuralgia is usually confined to one testicle.

Etiology.—Neuralgia of the testis, like that of the ovary, has been attributed to every possible reflex; but certainly its most potent cause is sexual excess or irregularity, frequently that unchaste continence which revels in the paraphernalia of indecency, lewd books, plays, tales, and thoughts, while seeking to hide beneath the cloak of physical propriety. Temporary irritable testis may be produced in a healthy person, at any time, by prolonged sexual excitement ungratified. Add to these physical causes a neurotic disposition and the picture is complete.

True reflex neuralgia is commonly seen in the course of a renal colic.

Lesions of the nerves and cord, notably tabes, may cause neuralgia.

It is frequently due to vesiculitis and to mild chronic epididymitis.

Course.—These patients are prone to become more and more self-centered and to look upon their condition as a pitiable one, ascribing it to loss of seminal fluid—perhaps to nocturnal emissions—to neither of which does it bear any relation.

Treatment.—The cure depends chiefly upon discovery and elimination of the cause. But so many of the obscure cases are due to sexual irregularity and chronic inflammation of the internal genitals that the following suggestions are of value:

1. The backbone of the cure is sexual reform. Sexual hygiene, which means strict purity of thought as well as action, must be insisted on. A strict celibacy is usually impossible to such patients, while a happy marriage affords them a natural antidote to the irritability of their sexual apparatus, and should be urged relentlessly if there is any decency left in them. At the same time the regulation of physical hygiene, exercise, diet, fresh air, regular hours, all must be minutely arranged.

2. Mild cases may be controlled by local applications of 10 per cent guaiacol in glycerin, aided by a suspensory bandage.

3. Brilliant cures are sometimes effected by rectal douching, massage of the vesicles, or cauterization of the verumontanum through the posterior urethroscope.

SYPHILIS OF THE TESTICLE

Syphilis of the testicle is a relatively common and characteristic lesion, which, like the other visceral lesions, is much more often found on autopsy than during life.

I have record of 67 cases, 10 of them bilateral. The following table shows the dates of onset:

AGE	CASES
4 to 7 months	3
12 to 18 "	5
2 years	4[1]
3 "	9[2]
4 "	6
5 "	1
6 "	4
7 "	3
8 "	1
9 "	2
10 "	1
11 "	4
12 "	3
15 "	2[1]
26 "	1
31 "	1[1]
Indefinite	17[3]
Total	67

It will be noted that, though three of the cases occurred between the fourth and the seventh month, the lesion is not common during the first year; though over half of the cases occurred within the first four years.

Yet the appearance of syphilis in both testicles is no evidence of a recent syphilis, as shown by its occurrence once in the fifteenth and once in the thirty-first year.

Morbid Anatomy.—The French school, following Dron,[4] recognize a secondary epididymitis and a tertiary orchitis or epididymo-orchitis. The distinction cannot be clinically established. Of my three earliest cases one was distinctly an orchitis.

The Testicle.—The syphilitic testicle usually shows marked interstitial sclerosis, sometimes considerable gummatous infiltration. Thus the process is the familiar sclerogummatous one. It progresses slowly and painlessly, often with little gross change in the organ.

[1] One bilateral.

[2] Three bilateral.

[3] Six bilateral.

[4] *Archiv gén. de méd.*, 1863, vol. ii, pp. 513, 724.

Active gummatous orchitis, however, may terminate by involvement of the overlying tissues and eruption through the skin, leaving a typical gummy ulcer.

The Epididymis.—The epididymis alone may be involved (I have seen this but twice), though more often the testicle is implicated as well. The lesion is usually confined to the globus major, which forms a hard, solid, infiltrated mass with a sharp edge. It caps the end of the testicle, separated from it by a distinct sulcus, so that the organ seems to be resting in a clam shell. Gummatous nodules are very rarely felt in the epididymis. This diffuse infiltration, sharp-edged, not nodular and not sensitive, is very characteristic of syphilis. The French speak of it as a "helmet crest."

I have in one instance seen syphilis begin in the epididymis as a rounded nodule, the size of a marrow-fat pea, and to progress by the addition of other nodules in the epididymis and in the testicle itself. These gummata so closely resembled tubercles that the testicle was removed under a mistaken diagnosis. Such rounded nodules in the epididymis, however, are extremely rare.

The Tunica Vaginalis.—Hydrocele is almost always present, but the amount of fluid is, as a rule, not very great. Adhesive vaginalitis is found after the fluid has been resorbed in the course of a cure.

Symptoms.—The characteristics of the syphilitic testicle are *painlessness and slow growth;* as a rule but one testicle is palpably involved. It does not attain a very great size; it does not ulcerate through the skin unless it has been neglected for a long time.

Examination reveals a testicle wooden in hardness. If the epididymis is involved, the sharp, clam-shell edge of the globus major (less often the globus minor) can usually be made out without drawing off the hydrocele fluid.

If there is orchitis, the testicle is either generally involved, evenly and densely hard, or else it is of uneven hardness, with projecting small gummata.

The vas deferens was involved in only one of my cases. The general health is not impaired, but, if both testicles are involved, sexual appetite and power are likely to be lost.

Not only is the testicle painless; it usually actually loses its testicular sensation. Indeed, the opposite apparently healthy organ is often equally insensitive, thereby evincing unsuspected implication in the disease.

Prognosis.—The prognosis is excellent. Whatever part of the parenchyma has not been destroyed by sclerosis will continue to functionate, and the testicle which has been syphilitic for years may still secrete spermatozoa. But the patient should be warned that the result of treatment upon an enlarged testicle may be to cause such absorption

of the syphilitic tissue as to reduce the gland far below its normal size, while any delay in instituting treatment will only make this atrophy more marked.

The hydrocele disappears with cure of the orchitis.

Diagnosis.—The diagnosis of syphilitic testicle is often easy from the appearance of the organ and the syphilitic history. Exceptionally, the onset of the disease is accompanied by mixed infection, so that for a time the testicle is tender.

This mixed infection is not obviously connected with gonorrhea, and usually leads to the diagnosis of tuberculosis.

The irregular involvement may lead to a diagnosis of neoplasm; but here the general rule applies absolutely: No testicle should be removed for neoplasm until the patient has been given the benefit of a test course of treatment, which test course should imply medication with salvarsan.

Treatment.—The general treatment is along the usual lines. We may not expect to bring a badly disorganized testicle back to an entirely normal condition. Local treatment is of no value. The hydrocele requires no treatment. Ancient syphilis of the testicle often resists every form of treatment short of mercurial injections and salvarsan.

TUMORS OF THE TESTICLE

The conclusions of Ewing's[1] classical study of neoplasms of the testicle, wherein he classifies almost all these confusing and varied neoplasms as teratomata form the foundation of our knowledge of this condition. We quote him as follows:

> In the testis one encounters a wide variety of neoplasms, from the most undifferentiated, diffusely growing, highly malignant, round cell tumors, up to fully adult and harmless tissues and organs, all of which appear to have one and the same origin, the slow or rapid unfolding of original potencies of sex cells. These facts seem to the writer wholly irreconcilable with any relation to an external parasite, but reveal in a striking manner that most important of all facts known about the origin of neoplasms, that embryonal cells possess more than any others the essential factors in the inception of tumors. . . .
>
> Pure fibroma arising from the stroma of the testicle has probably been observed, but is extremely rare.
>
> Pure leiomyoma arising from smooth muscle structures of the epididymis or corpus Highmori has probably been observed in a case of Trelat's, but does not appear in recent literature.
>
> Chondroma, myxoma, lipoma, rhabdomyoma, and carcinoma have not been shown to exist apart from a teratomatous origin. Primary lymphosarcoma arises in the testicle, but its exact cells of origin are as yet undetermined. It may first appear in the rete testis as do teratomata. Pure spindle cell sar-

[1] *Surg., Gynec. and Obstet.*, March, 1911, p. 230.

coma probably arises in the testicle, but is rare and its exact origin is uncertain.

Alveolar, large round cell, perivascular, and other forms of so-called sarcoma testis are of epithelial and teratomatous origin. Adenoma arising from the spermatic tubule cells is a rare tumor occurring in atrophic undescended testes.

Considerable hyperplasia but no true tumors of the interstitial cells have been observed.

The commonest tumor of the testis is an embryonal carcinoma alveolar or diffuse with polyhedral or rounded cells and often with lymphoid stroma. These tumors are probably one-sided developments of teratomata. . . .

That adrenal tissue may appear in true teratomata is shown by one of Ohkubo's cases and in the writer's case 16, a teratoma testis in its second recurrence was indistinguishable from many adrenal tumors. Further evidence would therefore seem necessary to establish the occurrence of a true testicular tumor arising from pure adrenal tissue. . . .

Standing out prominently from the maze of speculation in this difficult field are two main facts of observation.

Teratoma testis arises almost invariably where the spermatic tubules enter the rete testis and where some sex cells must fail to realize their full development into spermatogonia. Here is one of those transitional areas where tumors are prone to develop from superfluous and isolated cells.

Teratoma testis arises at all ages,[1] often after trauma, in testicles that appear to have been normal. The reasonable deduction is that all normal testicles contain the potential cells of origin of teratomata and that such rare accidents as isolation of blastomeres and fertilization of polar bodies are not concerned in their origin. It must be urged that no one has ever seen anything in the testicle which would directly connect teratomata with isolated blastomeres or polar bodies. The existence of such things in the testicle is purely hypothetical.

Influenced by these considerations the writer concludes from this study that teratoma testis arises from sex cells in the neighborhood of the rete, whose normal development into spermatogonia has been suppressed but whose potencies remain intact and ready to express themselves in the various forms of simple or complex teratomata.

The gross characteristics of the growth may be those of a dermoid cyst, or of a tumor of mixed tissue, solid or cystic, or of a rapidly growing malignant growth.

Secondary hydrocele is a relatively unimportant feature.

Metastases occur early by way of the lymphatics. Later the whole pampiniform plexus of veins may become involved in the growth.

SYMPTOMS

Since malignant tumors of the testicle often appear benign at the outset, and since apparently benign tumors may at any time become malignant, tumor of the testicle should always be regarded as menacing its possessor's life. Thus in one of Conché's cases (Sturgis) the tumor

[1] The great majority, however, between the ages of 15 and 30.

began to grow after having been quiescent for five years. On the other hand, in a case recorded by Socin, in six months the tumor attained the size of a man's head, and Sturgis's case of sarcoma grew in a year to the size of a child's head. Kocher collected 32 cases, 25 of which came under observation within a year and a half of the beginning of the disease, and of which only 1 had lasted six years—an average of one year and four months; while 83 of Kober's "sarcoma" cases show an average of two years and eight months from the beginning of the disease to the time of

FIG. 125.—CARCINOMA OF TESTICLE. The organ is completely destroyed by the growth. There is hydrocele. (Case of Dr. G. D. Stewart.)

operation. The pain is often slight throughout, though it may well become severe in the later stages. Testicular sensation is lost.

The oval shape of the testicle is preserved. As the tumor grows it may be evenly elastic or uneven, nodular, elastic in places, perhaps fluctuating when there are large cysts or a flaccid hydrocele. Finally, the scrotal veins enlarge, the iliac and lumbar glands can be felt by deep abdominal palpation, and, ultimately, the tunica albuginea gives way and elastic masses can be felt projecting through it. Thence the fascia and skin are involved and the tumor eats its way through the tense integument, forming the malignant fungus, the *fungus hematoides* of the testicle. This occurred only once in Kober's 114 cases. The inguinal glands do not enlarge until the scrotum becomes invaded by the growth, for the lymphatics from the testicle run directly up the cord to the iliac and lumbar glands.

DIAGNOSIS AND TREATMENT

It is well to remember that every neoplasm of the testicle is possibly syphilitic until the contrary is proved. A short, sharp course of treatment will decide. If this fails, any lump within the testicle should be treated as tumor, by operation.

Curiously enough the more vascular, rapidly-growing type of growth may readily be mistaken for hydrocele. Twice in my experience this had led to the unpardonable use of aspiration for a diagnosis.

CHAPTER LXII

HYDROCELE, HEMATOCELE, SPERMATOCELE, CHYLOCELE

Hydrocele is usually defined as an accumulation of serous fluid in the tunica vaginalis. Hydrocele may also occur in the funicular process of the peritoneum (encysted hydrocele of the cord).

Varieties.—Hydrocele may be idiopathic or symptomatic. It may be acute or chronic. While all idiopathic cases are chronic, not all symptomatic cases are acute, therefore the terms are not quite interchangeable.

SYMPTOMATIC HYDROCELE

As its name suggests, symptomatic hydrocele occurs only as a symptom of disease in the testicle and epididymis. It is often acute, and is especially common with acute epididymitis and tuberculosis. A *fibrous adhesive vaginalitis* has been identified post mortem or during operation. It gives no clinical symptoms.

Treatment.—The treatment of symptomatic hydrocele is, in some degree, comparable to the treatment of serous pleurisy. If the primary disease is acute and the hydrocele insignificant, it may be disregarded and allowed to be absorbed as the acute disease abates. If large and tense, or its absorption too slow, it may be aspirated one or several times. But if the primary disease is chronic, while aspiration may hold the hydrocele in check, some more radical procedure is often demanded. The treatment by injection usually fails. The need of a more radical procedure may prove the surgeon's opportunity to induce the patient to submit to an operation upon his testicle from which he otherwise would shrink.

IDIOPATHIC HYDROCELE

Most French writers maintain that there is no such thing as idiopathic hydrocele, that every *vaginalite séreuse* is symptomatic. This theory does not explain why idiopathic hydrocele is so common in the tropics, or why idiopathic hydrocele does not often follow acute epididymitis, a disease which leaves far greater changes in the epididymis than those alleged as cause of idiopathic hydrocele.

Varieties.—Hydrocele is usually confined to the tunica vaginalis (Fig. 126). In infants, however, it may occur before the funicular process has begun to close (*congenital hydrocele*), so that the cavity of the hydrocele communicates with the peritoneal cavity, yet by such a small opening that there is often no hernia and the fluid does not spontaneously drain off into the abdomen (Fig. 129). A more frequent variety is *infantile hydrocele,* occurring when the funicular process has quite closed at its upper end, so that the fluid distends both vaginalis and funicular process (Fig. 130). Hydrocele occurring in a retained testis is termed *inguinal hydrocele.* These and other varieties mentioned above will be dealt with later.

Etiology.—Hydrocele does not occur as a dropsical phenomenon, and it has already been distinguished from inflammatory or symptomatic vaginalitis. It is possible that certain cases are due to the bursting of an epididymal cyst into the tunica vaginalis,[1] but beyond this we are quite in the dark as to its cause.

Hydrocele is most common in the middle-aged. In the tropics it is said to afflict one man in ten. It is far less common in temperate climes.

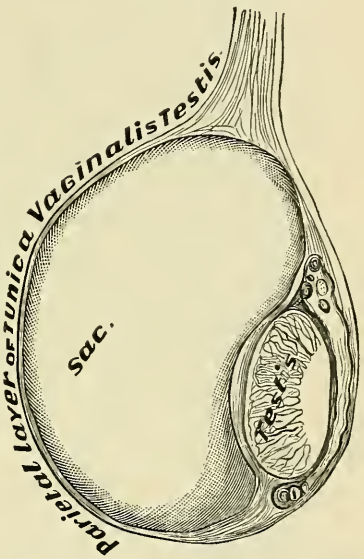


Fig. 126.—Usual Form of Hydrocele.

Pathology.—The Character of the Fluid.—The fluid of hydrocele is viscid, odorless, straw-colored, clear, or opalescent. It looks like blood serum. Its specific gravity is about 1.024. It contains about 6 per cent of organic matter, notably fibrinogen, to which it owes its property of coagulating blood serum. The alkaline carbonates and sodium chlorid are present in some quantity. The reaction is neutral. The presence of fibrinogen and inorganic salts distinguishes it from ascitic fluid. It may contain a few flakes and strings resembling urethral shreds. It is sometimes full of bacteria, sometimes brown from the admixture of blood. These bacteria and this blood are usually the result of previous punctures. The microscope reveals blood and epithelial cells and leukocytes. Cholesterin crystals are usually present, not often in any numbers. Suppuration is rare.

The Quantity of Fluid.—A good-sized hydrocele contains some 200 or 300 c.c. of fluid. Mr. Cline removed 6 quarts from the scrotum of Gibbon the historian. Breisson, after removing 16 liters on one occa-

[1] *Lancet,* 1885, i, 748.

sion, drew 26 liters from the same patient ten months later. It takes from three months to a year for a good-sized hydrocele to refill after tapping. The largest hydroceles I ever operated upon held 2,500 c.c. and 1,500 c.c. (right and left sides of the same patient).

The Tunica Vaginalis.—The sac of a hydrocele may remain normal in structure even after the disease has existed for some time.

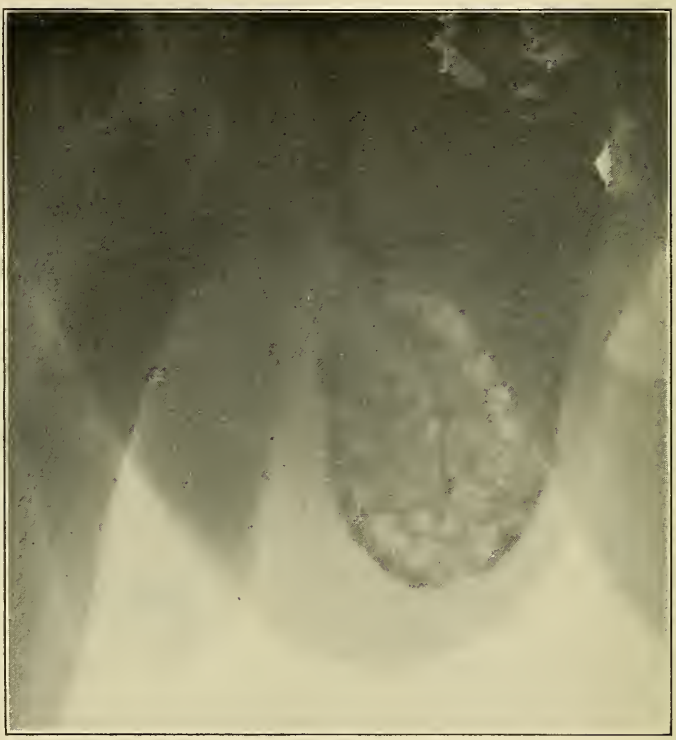


Fig. 127.—Radiogram of Calcified Tunica Vaginalis.

Support to the testicle and systematic tapping may prolong this condition indefinitely. But if the scrotum is not supported, the slight bruising which the tumor continually suffers may produce a chronic thickening in the tunica vaginalis; the surface loses its gloss and becomes wrinkled and irregular, while the vaginalis becomes thick and leathery. Adhesions and masses of fibrin result from inflammation. Obliteration of some part of the sac may subdivide it, causing the rare *multilocular hydrocele.* I have twice met with *calcification of the vaginalis,* a very rare condition, which has been exhaustively described by Roswell Park.[1]

[1] *Jour. of Cut. and Gen.-Urin. Diseases,* 1895, xiii, 361.

The Testicle and Epididymis.—Unless inverted or displaced by adhesions, the testicle lies below and behind the hydrocele. In mild cases the testicle remains normal, but after evacuation of the fluid one or more areas of induration may commonly be found in the epididymis. These are points of intertubular edema due to the interference with circulation. In old and inflamed cases of hydrocele, both testis and epididymis may be quite sclerosed and so atrophied as to be scarcely recognizable in the sac wall. Sometimes the tunica vaginalis forces its way between the testicle and epididymis, forming quite a pouch there.

Multilocular Hydrocele.—Multilocular hydrocele is quite rare. It may be produced in one of three ways:

1. Several varieties of hydrocele exist simultaneously (e. g., hydrocele of the vaginalis and hydrocele of the cord).
2. The sac becomes subdivided by adhesions.
3. There is hernia of the sac between testis and epididymis.

Fibrous Bodies.—The so-called fibrous bodies occasionally met with upon opening a hydrocele are concretions of earthy phosphates or carbonates covered with fibrin. Probably they are for the most part due to a deposition of the hydrocele salts upon some warty growth, followed by atrophy of the little nucleus, after which the concretion breaks free. Wendlung met with concretions 6 times in 109 operations (Péraire[1]). They do not exceed the size of a pea—though Chassaignac found one 2 cm. long and 12 mm. wide—and are usually single.

Symptoms.—Idiopathic hydrocele is always chronic. The effusion takes place slowly and painlessly, and the swelling is only discovered after it has attained some size, for which reason the patient fancies it has appeared suddenly. The accumulation of fluid is slow and interrupted, but continues indefinitely. After tapping, the reaccumulation is at first rapid and then slow until the tumor reaches its original size, usually several months after tapping. Thus I have a patient who, refusing any radical measures, returned twice a year for 11 years to be tapped, having, for a number of years previous to that date, visited other surgeons for the same purpose.

There are no subjective symptoms attached to hydrocele, except the sensation of dragging felt in the loin and groin from the weight of the tumor.

Signs.—Hydrocele is usually pear-shaped, larger below than above; or it may be oval, and, if very large, sausage-shaped. It cannot be reduced by pressure. Fluctuation can usually be made out. The tumor is generally tense, the scrotum often stretched and shining. The cord, of natural size and feel, can be grasped above the tumor. The testicle

[1] *Bull. de la soc. anat.*, 1899.

is usually situated behind, a little below the center (Fig. 126), and pressure on this point gives rise to the peculiar sensation experienced when the testicle is squeezed. Occasionally the testicle is found below and in front, more rarely in the center, in front, from plastic adhesion. Its position should always be ascertained before operating on a hydrocele. Pressure on a hydrocele does not produce pain; there is no heat or redness of the skin unless the tumor be large enough to keep it constantly on the stretch. There is flatness on percussion. There is no

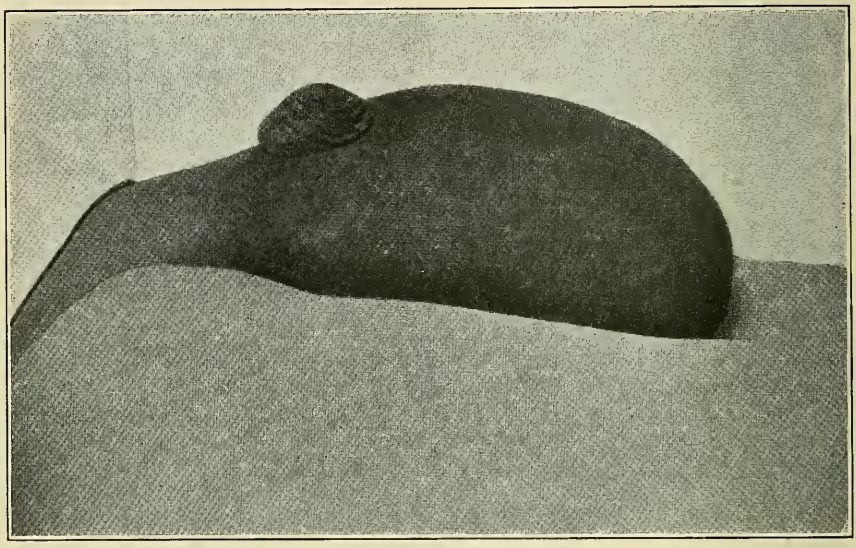


Fig. 128.—Hydrocele.

impulse on coughing, unless the hydrocele extends into the inguinal canal or is complicated by hernia.

The weight of the tumor is a criterion that has been much depended upon to distinguish solid from fluid tumors. It is absolutely unreliable.

Varicocele and hernia may complicate hydrocele, and the pressure on the testicle may render it sterile. But if the hydrocele is cured the testicle will resume its functions unless it has become atrophied.

Diagnosis.—The diagnosis is made by three tests:

1. The light test.
2. Isolation of the tumor.
3. Puncture.

The Light Test.—Most hydroceles are so thin-walled that if an electric bulb or a candle is held close to one side of the tumor and the opposite side inspected through a tube (e. g., a roll of paper), the whole mass glows with a pinkish light. The position of the testicle may even be discerned by its shadow.

This test rules out hematocele, most spermatoceles, and solid tumors of the testicle, but does not exclude a complicating hernia.

If the walls of the hydrocele are thickened, the light test fails.

If the test fails in a case that has every other aspect of hydrocele, it is doubtless a spermatocele.

Isolation of the Tumor.—If the fingers can be brought together above the tumor and feel nothing but the normal tissues of the cord, hernia is excluded.

If the tumor runs into the inguinal canal and gives no impulse on coughing, there is *probably* no hernia.

Puncture.—The tumor should not be punctured unless hernia can be *absolutely* excluded by isolation, and tumor by the light test. It is, in other words, both dangerous and unnecessary.

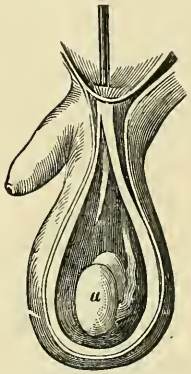


Fig. 129. — Congenital Hydrocele.

Prognosis.—Hydrocele in the adult does not get spontaneously well.

Suppuration and transformation into hematocele are rare. Curling cites the case of a Spaniard who had ruptured his hydrocele thirty times by horseback riding and other violent exercises; yet the swelling always returned after a few months. Infants often get well spontaneously, and expectant treatment is therefore most suitable for them.

Treatment.—Tapping.—This is appropriate to symptomatic hydrocele, for children—for whom it is often curative—and for patients refusing radical measures. Before tapping for hydrocele the testicle must be accurately located by the testicular sensation or the light test, and hernia and tumor must be *absolutely* excluded.

Hydrocele in the adult will usually refill after this operation, but for children it often suffices, especially if the internal surface of the sac be scratched. If the cyst wall be thick tapping will never effect a cure. The patient can put on a suspensory bandage and resume work at once after tapping.

Radical Treatment.—Of the many methods of treating hydrocele only two need be detailed—namely, injection and open operation.

The choice between these operations is discussed in Chapter LXXX.

CONGENITAL HYDROCELE

In congenital hydrocele there has been no obliteration of the peritoneal prolongation, and the tunica vaginalis is continuous with the peritoneum (Fig. 129). It occurs in infancy.

Diagnosis.—The diagnosis is usually easy, but there is some danger of confusion with hernia.

Congenital hydrocele and hernia usually coexist.

Congenital hydrocele may be found in adults, but is rare. Horwitz met with it once in 110 cases. Kocher estimates that it occurs 4 times in every 100.

Treatment.—Open operation; never injection.

INFANTILE HYDROCELE

Infantile hydrocele is far more common than the congenital variety. Horwitz met with 22 cases. The hydrocele occupies the tunica vaginalis and the funicular process up to the inguinal canal, where it is shut off from the general peritoneal cavity (Fig. 130). It resembles a congenital hydrocele, but is quite irreducible.

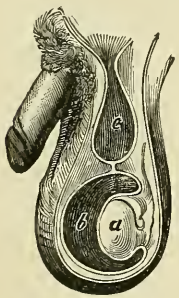


Fig. 130.—Infantile Hydrocele.

Treatment.—Since these hydroceles are usually complicated by hernia, they should never be injected, always subject to open operation.

Abdominal Hydrocele (*Bilocular hydrocele, hydrocèle en bissac*).—This is a very rare variety of infantile hydrocele, in which the hydrocele is partly in the scrotum, partly in the abdomen. The abdominal portion, which may grow to an enormous size, usually lies between the general peritoneal cavity and the anterior abdominal wall. By pressing the abdominal muscles the patient can force the fluid violently into the scrotum.

Treatment.—Excision of the sac. I have operated upon one case in which the tumor reached to the umbilicus. The sac was readily freed through an abdominal incision. It was then readily drawn down and excised through an incision over the inguinal canal. The canal was then repaired by the Bassini method.

ENCYSTED HYDROCELE OF THE CORD

Conditions commonly grouped as encysted hydrocele of the cord are:

1. Hydrocele of the processus funicularis.
2. Pedunculated cysts of the epididymis.
3. Hydrocele of an old hernial sac.

1. **Hydrocele of the Processus Funicularis.**—The sac is shut off below from the tunica vaginalis, above from the peritoneum. The hydrocele may be single or multiple. Usually single, it presents the

features of a hydrocele of the tunica vaginalis, but is situated above the testicle and about the vas. Sometimes it may be reduced into the inguinal canal, but never into the abdomen. Although it usually occurs in children, I have several times seen it in the adult.

2. (See below.)

3. Hydrocele of an Old Hernial Sac.—This occurs in the process of peritoneum left behind by a hernia which has been reduced and the neck of the sac closed, either spontaneously or by the use of the injection cure for hernia. The hydrocele is usually mistaken for a recurrence of the hernia.

Treatment.—The sac should be incised and its parietal layer removed.

Hematocele.—Hematocele of the cord is rare, but may occur in the same way as hematocele of the tunica vaginalis, usually after injury. Indications for treatment are the same (p. 608).

MULTILOCULAR HYDROCELE OF THE CORD

Multilocular hydrocele of the cord was first described by Pott and Scarpa as diffuse hydrocele of the cord, and most authors retain that title. The pathogenesis of this rare affection is habitually misunderstood. Kocher,[1] however, after a critical survey of the literature, concludes that an actual diffuse hydrocele can be due only to a rupture of some hydrocele or spermatocele, a temporary accumulation of fluid in the connective tissue about the cord. All other cases he classifies under five heads, viz.:

1. Echinococcus cyst.
2. Spermatocele.
3. Encysted hydrocele of the cord subdivided into loculi by adhesive inflammation.
4. Cysts of fetal remains (Müller's Duct, Wolffian Body, Organ of Giraldès).
5. Cystic lymphangioma.

Symptoms.—The symptoms are characteristic, whatever the nature of the disease. The tumor extends about the cord from the testis up or into the spermatic canal. It is smooth, rounded, translucent, and boggy rather than fluctuating, though a difference in this regard may be made out in different parts of the tumor. It may be partly reducible. There is a slight impulse on coughing.

Diagnosis.—The diagnosis from encysted hydrocele of the cord is established by the boggy feel and the irregular, indistinct outlines of the tumor. In fact, it resembles an incarcerated omental hernia in every-

[1] *Op. cit.*, pp. 170, 180.

thing but its translucency and its fluctuation in places. Incision may be required to establish the diagnosis.

Treatment.—The tumor may safely be let alone. To cure it incision has usually been employed. Pott's classical case of lymphangioma died of lymphorrhagia after incision.

CYSTS OF THE EPIDIDYMIS—SPERMATOCELE

This condition, commonly known as spermatocele or encysted hydrocele of the testicle, is a collection of fluid "contained in a cyst or cysts, distinct from but close to the cavity of the tunica vaginalis" (Jacobson). These cysts are developed in and about the epididymis, very exceptionally in the testicle itself, and should be classified as epididymal cysts. Two classes may be recognized:

1. Small cysts developing (usually) about the epididymis.
2. Large cysts originating within the epididymis.

1. The *small cysts* are rarely encountered before middle age, while they are very common in later life. They usually project more or less distinctly from the head of the epididymis. They do not attain any notable size; they rarely contain spermatozoa—in short, they have little clinical significance.

2. The *large cysts* usually appear before middle age and commonly contain spermatozoa. They are often multiple and grow between the epididymis and the testicle, separating them and unraveling the former. Thus they form irregular fluid tumors about the top of the gland. Exceptionally, the cysts are pedunculated and grow upward, simulating hydrocele of the cord.

I have seen four cases that precisely simulated hydrocele of the tunica vaginalis in every respect except translucency. The sac lay in front of the testicle with the vaginalis between.

These cysts rarely contain more than 100 c.c. of fluid, though Curling drew off 32 ounces from one individual and 40 ounces from another. Jacobson mentions a case from whose right side 49 ounces were drawn, and 58 from the left. Frost's[1] cases yielded 52 ounces. The nature of these large cysts is identified by the fact that the fluid is milky and swarming with spermatozoa or else absolutely watery.

Pathogenesis.—Since the smaller cysts are met with later in life than the larger, and less frequently contain spermatozoa, many authors attribute the larger cysts to persistent fetal remains, such as the vasa aberrantia, the hydatid of Morgagni, or the paradidymis (organ of Giraldès), and the smaller cysts to dilatations of the seminal canals. The recent tendency, however, has been to discredit the claims of the

[1] *Lancet*, 1878, ii, 482

fetal elements, and to attribute the earlier and larger cysts to dilatation of the vasa efferentia or of the epididymis itself behind an obstacle more or less impervious,[1] and the later, smaller tumors to a cystic enlargement of the tubules due to senile changes after the organ has passed the height of its activity.

The presence of spermatozoa in the cysts is explained by those who cling to the theory of embryonal rests upon the ground that the cyst has burst into the epididymal canal. *The absence of spermatic elements* is explained by those of the opposite camp on the ground that the cysts become occluded from the main channel and their seminal elements gradually disintegrate. The communication between a cyst and a seminal duct has been observed a number of times.

Symptoms.—The *small cysts* are occasionally met with in older men. They produce no symptoms.

The *large cysts* have peculiar features. If seen early, an undefined sense of thickening, with extra resistance, is distinguishable by the finger in the region of the top of the testicle. This goes on increasing, usually at so slow a rate that the patient soothes himself with the idea that it will become no larger. It grows constantly, however, and may attain a large size. There is no pain, except a slight dragging on the cord. The cyst keeps its position at the upper end of the testicle, or extending down in front of it. It may be "heart-shaped," the testicle lying below the cyst which is notched above. The walls are usually thin and tense, so that fluctuation cannot always be distinguished. Translucency is rarely present.

The cyst tends to increase in size indefinitely. It may coexist with hydrocele and be masked by it. It may be broken into the vaginalis by accident, and, continuing to secrete, form spermatic hydrocele, or it may be punctured when a supposed simple hydrocele is tapped.

Diagnosis.—The heart shape of the cyst, though pathognomonic when present, is not constant. The diagnosis is usually made by the irregular shape and position (above the testicle) of the tumor or the absence of translucency in a supposed hydrocele. Aspiration usually completes the diagnosis by withdrawing a milky fluid full of spermatozoa. If the fluid is limpid it may be distinguished from hydrocele fluid by its watery limpidity (whereas hydrocele fluid is straw-colored), its neutral reaction, its low specific gravity (less than 1.010), and its low percentage of albumin (about ½ per cent against 4 per cent to 7 per cent in hydrocele).

[1] Griffiths (*Jour. of Anat. and Phys.*, 1893-94, xxviii, 107) maintains that, like hydronephrosis, these dilatations are caused by partial obstruction due, in this case, to catarrhal inflammation. He also maintains that the hydatid of Morgagni is always a solid body, never cystic, and that there is no evidence that embryonal remains are in any way connected with spermatocele.

Treatment.—The cyst should be excised. There is no object in disturbing small cysts.

HEMATOCELE

The term *hematoma* is applied to a tumor caused by the effusion of blood into the tissues, whether of the testis or the scrotum. If the effusion becomes encysted, or if it occurs within a cyst or the serous tunic of

Fig. 131.—Hematocele. The sac is filled with hardening jelly; hence the mosslike fringe. The slight thickening at the bottom is all that remains of the testicle.

testicle or cord, *hematocele* results (Fig. 131). I have seen a hematospermatocele.

Etiology.—The most common cause is a crushing injury. Any operation upon the testis may result in hematocele.

Scrotal hematocele and testicular hematocele are always traumatic. Vaginal hematocele is usually traumatic, but, exceptionally, may have a spontaneous origin.

Symptoms.—There are consequently two varieties. The one comes on rapidly after injury and is attended by scrotal hematocele. If there has been a pre-existing cyst or hydrocele this becomes suddenly larger, more tense, and painful.

In the other, or spontaneous variety, the tumor increases slowly in size and simulates hydrocele, except in regard to translucency.

The blood in hematocele may be found red and fluid, but is usually black or brown, and it may be mixed with pus if severe inflammation has followed its effusion. The walls of the cyst may be coated with layers of fibrin, and they tend to thicken and become adherent to the surrounding connective tissue, while the inner surface becomes rough and uneven, resembling anything but a serous surface.

Diagnosis.—The diagnosis of hematocele of the second or spontaneous variety presents many difficulties. Here there is no guide in the history nor any local signs of injury. The records of surgery possess many cases where perfectly healthy testes, surrounded by a hematocele inside of a thickened tunica vaginalis, have been extirpated as cancerous. The diagnosis cannot be made without an exploratory incision.

In the traumatic variety, the diagnosis is made at once from the history. It is unimportant, often impossible, to distinguish between traumatic hematocele of testis, vaginalis, and scrotum.

Treatment.—For *hematoma* all that can be done is to keep the patient upon his back, with the testicle supported and covered with cold lotions, administering an anodyne if the pain be severe. If the quantity of blood effused is not too great, the pain will soon begin to subside, and the patient may be allowed to go about with a suspensory bandage. The blood will gradually be absorbed.

If, in spite of these means, the pain becomes excessive, and the tension of the parts great, the tumor should be incised and drained.

Ancient hematocele demands castration.

CHYLOCELE

Chylocele (fatty, milky, chylous hydrocele, galactocele) is an accumulation in the tunica vaginalis of chyle or fatty lymph. It is a feature of lymph scrotum, and is caused by the rupture of a dilated lymph vessels into the tunica vaginalis. Filarial embryos have been seen in the fluid by Martin and Davies. Chylocele may also be due to traumatic rupture of a lymphatic into the tunica vaginalis. False chylocele is due to a fat- or cholesterin-producing degeneration in the fluid or in the epithelium of a hydrocele.

Chylocele when occurring without lymph scrotum resembles hematocele. The treatment is excision.

CHAPTER LXIII

DISEASES OF THE VAS DEFERENS AND SPERMATIC CORD

ANATOMY

The *cord* is made up of the vas deferens, the habenula or remains of the funicular process of the peritoneum, and certain vessels and nerves, all held together by meshes of connective tissue containing unstriped muscular fiber (internal cremaster of Henle). Surrounding these is a continuous layer of connective tissue (tunica vaginalis communis) adherent to the tunica vaginalis below and continuous with the fascia transversalis above. Outside of this the cremaster muscle lies in loops, some of them embracing the testicle, others extending only a short distance down the cord.

The *arteries* are, the spermatic from the aorta, the deferential from the superior vesical, and the cremasteric from the epigastric. The *veins* from the testicle and epididymis unite in the *pampiniform plexus* which constitutes the bulk of the cord. The larger veins have valves; they usually unite within the abdomen to form one large trunk, which empties, on the left side into the renal vein, on the right side into the vena cava. A much smaller bundle of veins accompany the vas and the spermatic artery. The spermatic plexus of *nerves* is derived from the renal, the aortic, the superior mesenteric, the hypogastric, and the lumbar plexuses of the sympathetic, the genital branch of the genito-crural nerve, and the inguinal branch of the ilio-inguinal.

The *cremaster* muscle varies in size and power in different subjects. Its function is to assist in sustaining the testicle by its tonic contraction, and to compress the organ during the sexual orgasm. The muscle is subject to painful spasmodic contraction in kidney colic, in neuralgia of the testicle, and sometimes in connection with prostatic, or vesicular irritation. The *cremasteric reflex* is the retraction of the testicle excited by irritation of the adjoining portion of the thigh.

The Vas.—The vas deferens is the excretory duct of the testicles. It runs upward from the tail of the epididymis to form one of the main constituents of the spermatic cord. It lies in the inner and posterior portion of the cord, where it may be identified as a rigid tube, the only element of the cord that does not slip almost insensibly from between

the examining fingers. After passing through the inguinal canal the vas curves obliquely downward and backward over the base of the bladder, crosses behind the ureter and runs to the inner side of that duct, separated from it by the seminal vesicle. At this point it becomes markedly sacculated, forming the *ampulla* of the vas, then narrows to its original dimensions, and is joined by the duct of the seminal vesicle to form the *ejaculatory duct,* which pierces the prostate and opens into the posterior urethra just in front and to one side of the verumontanum.

The vas deferens is lined throughout with columnar epithelium. Its muscular coat consists of two layers, the inner circular, the outer longitudinal. Surrounding all is a dense fibrous tissue.

Relations.—The chief relations of the vas have been described above. In the scrotum it is closely surrounded by its own artery and one or two small veins. These vessels and the nerves run near it, and, except for a few veins to the inner side, the whole pampiniform plexus lies to its outer side.

Anomalies.—Curling [1] relates a number of cases reported by various authors, in which the vas deferens was absent wholly or in part, on one or both sides. When the testicular end is missing the epididymis may or may not be missing as well.

Wounds.—Wounds of the cord may cause profuse hemorrhage and rupture of the vas. The hemorrhage may be checked readily enough. If the vas is cut it should be united by Belfield's method (p. 777). If some such operation is not performed, the duct becomes occluded, and, although this does not cause atrophy of the testicle, yet it shuts off the spermatozoa of that side from the urethra.

Complete division of the cord may cause atrophy of the testicle. Division of the pampiniform plexus causes only a temporary edema.

Torsion of the Cord.—(See p. 589.)

Inflammation.—(See p. 568.)

Hydrocele and Hematocele.—(See p. 604.)

VARICOCELE [2]

Varicocele is varicosity of the veins of the pampiniform plexus. It may be either symptomatic or spontaneous.

Symptomatic Varicocele.—Symptomatic varicocele is rare. It is caused by the pressure of some intra-abdominal growth obstructing the spermatic veins. The tumor is usually of renal origin and malignant (p. 492).

[1] "Diseases of the Testis," 4th ed., 1878, p. 7.

[2] Cf. Istomin, *Deutsche Zeitschr. f. Chir.,* 1909, xcix, 1.

Diagnosis.—Symptomatic varicocele cannot be mistaken for spontaneous varicocele. It develops very rapidly, late in life, on either side; is painless, attains large proportions, and is associated with a palpable abdominal tumor, against which the treatment should be directed.

Spontaneous Varicocele.—Varicocele in a mild form is perhaps the most common affection of the genital organs. It has been estimated that about 10 per cent of males have slight varicocele.[1] It occurs almost invariably on the left side; when very marked on this side it may exist slightly on the right. Breschet, in 120 operations, operated only once on the right side. I have never operated on both sides.

Most slight varicoceles are encountered in young unmarried men; the affection rarely commences after twenty-five; it is unusual to find it in a married man whose sexual relations are satisfactory. The chief factor in its production is ungratified sexual desire, unrelieved erotic fancies, or, less often, the opposite condition, abuse of the sexual powers, by which the veins are kept constantly engorged. The slight turgescence of the veins constituting varicocele in a young bachelor and often causing him needless alarm, disappears after marriage, together with the uneasy sensations which accompanied it.

Old men whose testicles are inactive rarely have varicocele, though their legs show many tortuous veins. This fact is of the utmost importance. That slight varicocele is often a sexual derangement, a functional disorder depending upon vicious sexual hygiene, is not sufficiently appreciated by practitioners. In many cases young men distress themselves unceasingly, and importune their surgeons for an operation to cure a disorder which would be more speedily and effectually removed by marriage.

The degree of varicocele alluded to above may be dismissed briefly. The vessels are a little full, the cord loose, feeling like a small bundle of earthworms, no one vessel being exceptionally large; the testicle is perhaps oversensitive, and there is usually a slight dragging sensation in the groin, but beyond this nothing except the fancied ills and the hypochondriacal complainings of the young man who is cheating Nature or abusing her gifts. The proper treatment of such cases is sexual hygiene. The patient's mind must be diverted, he must be dissuaded from an operation, told to wear a snugly fitting suspensory bandage, and as far as possible to forget his sex until marriage affords him an opportunity to get well. The free local application of cold water daily is a very useful adjuvant.

Yet varicocele serious enough to constitute a disease and to demand active surgical measures for its relief does occur. It is an exaggera-

[1] Bennett estimates 7 per cent., while Senn states that among 9,815 recruits 2,075 were affected with varicocele.

tion of the milder form; it comes on in early manhood, and has no connection with varices of the legs or anus (hemorrhoids).

Pathogenesis.—Any theory to be adequate must explain the prevalence of the disease among the adolescent and its occurrence, almost entirely, upon the left side.

Many authors look for an anatomical predisposing cause. Thus certain French writers invoke a pre-existing phlebitis. Bennett [1] and Spenser [2] suppose a congenital anomaly of the veins. Such predisposing causes are not generally accepted. Sufficient anatomical predisposition is found in the position of the veins, dependent, unsupported, surrounded by the loosest kind of a fascial envelope. To this add the congenital congestion set up by the untamed and pampered passions of youth, and no further predisposing cause is necessary.

But why should the varicocele occur upon the left side? To answer this question an infinite variety of theories has been proposed. There is space to enumerate only the more important ones. The left testis hangs lower than the right, and the left renal vein is higher than the opening in the cava which receives the right spermatic vein, hence the left vein is longer than the right. To this add the fact that the left spermatic vein, enters the renal vein at right angles, and is not affected by suction as is the right vein which enters the cava at an acute angle. So far we are on safe anatomical ground; beyond all is theory. Perhaps, as has been alleged, right-handed men transmit the force of their exertions to the left foot by means of the abdominal muscles of the left side. But I have seen left-handed men with varicocele, always on the left side. Perhaps the sigmoid flexure, overloaded with feces, presses upon the veins. But this is as rare in youth when varicocele is common, as it is common in old age when varicocele does not occur. Curiously enough the ovarian veins are very rarely varicose, except on the left side.

A violent strain may induce acute varicocele.

Pathology.—In mild cases the veins are merely tortuous and dilated. But in a full-formed varicocele the vessels are elongated, their valves broken down, their walls affected by fatty atrophy, and thickened. The veins sometimes contain phleboliths, or become thrombosed throughout, as a result of phlebitis.

Symptoms.—I have seen a number of cases of *acute varicocele* resulting from straining, or coming on spontaneously.

Except in acute cases, such as those just detailed, *varicocele comes on gradually,* and is discovered by accident. The amount of *pain* complained of varies greatly; a very large varicocele is usually attended by absolutely no pain, while a very slight enlargement of the veins

[1] "On Varicocele," London, 1891.

[2] *St. Barthol. Hosp. Rep.,* 1887, p. 137.

may give rise to considerable uneasiness extending up the back and down the thigh, perhaps amounting to neuralgia of the testis.

The only *general symptoms* of varicocele besides pain are those of hypochondria and defective *morale*. The impotence often alleged by physicians of an incredible "years' experience" to result from varicocele is the veriest fiction. When impotence and varicocele co-exist they are due to the same causes; but neither is the impotence due to the varicocele nor the varicocele to the impotence.

The *local conditions* are typical. The left testicle hangs considerably lower than the right, borne down, and perhaps completely surrounded by the mass of dilated veins. The mass feels soft, like a bunch of earthworms. The scrotal veins may be similarly affected. The scrotum is thin and relaxed, the dartos powerless. In long-standing cases of severe varicocele the testis gradually atrophies because of the interference to its circulation. This result is in no way due to the weight of the mass of veins.

The course of the disease is usually not progressive. Of the many men who have slight varicocele, only the smallest percentage fail to get well under the regulated sexual exercise of married life. Exceptionally, however, the veins do grow and enlarge indefinitely.

Diagnosis.—There are few diseases more readily recognizable than varicocele; the peculiar appearance and wormy feel of large tortuous veins can scarcely be confounded with anything else.

Treatment.—If the varicocele be small and its symptoms inconsiderable, the patient should be advised as to his sexual hygiene, perhaps instructed to wear a suspensory bandage and treated for neuralgia of the testicle, if this is a feature of his condition. If these measures fail, or if the patient insists upon more radical treatment, surgery must be employed (p. 777).

TUMORS OF THE CORD

Cystic Tumors.—See Hydrocele of the Cord (p. 604).

Solid Tumors.—Solid tumors of the cord are rare. Fibroma, fibromyoma, and sarcoma, all of the vas deferens, have been observed in isolated instances. Gumma is very rare (Goldenberg).[1] The only tumor of clinical importance is lipoma of the cord. The frequency of lipoma of a hernial sac lends color to the theory that lipoma of the cord is secondary to hernial lipoma. In structure the tumor may be a pure lipoma, a fibrolipoma, or a myxolipoma.

These tumors are usually small and reducible into the inguinal canal, simulating epiplocele, from which they are only differentiated

[1] *Jour. of Cut. and Gen.-Urin. Diseases,* 1901, xix, 113.

by operation, unless they can be drawn entirely out of the canal. Exceptionally, however, they attain an extraordinary size. Nové-Josserand [1] reports a specimen weighing 6½ kilos, and cites two others weighing respectively 20 and 15 pounds. The larger tumors may be pathologically benign and yet clinically malignant.

[1] *Lyon méd.*, 1897, lxxxiv, 237.

CHAPTER LXIV

DISEASES OF THE SEMINAL VESICLE

ANATOMY

The seminal vesicle (Fig. 132) is a reservoir connected with the vas deferens. Each vesicle lies to the outer side of its vas, its apex buried in the prostate, where it joins the vas at an acute angle to form the ejaculatory duct. The body of the vesicle is directed obliquely upward and outward, lying along the upper border of the prostate and projecting beyond it laterally. The fundus of the vesicle lies just external to the termination of the ureter in the bladder. Each vesicle is bound close to the bladder and prostate by the fascia of Denonvilliers, a dense envelope. This fascia is the relic of that portion of the peritoneum that in the fetus separates the budding bladder from the rectum. It begins at the apex of the prostate, covers the posterior surface of this gland, forms the posterior sheath of the seminal vesicles and merges into the peritoneal reflection above. Within this fascia ramify numerous large branches of the prostatic plexus of veins. The relation of the vesicles to the peritoneum is variable. The rectovesical pouch touches the fundus of each vesicle; when the bladder is full there is a triangular extraperitoneal space between the vesicles, just above the prostate.

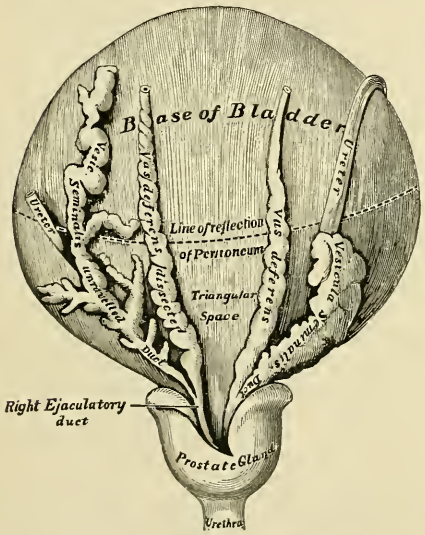


Fig. 132.—Seminal Vesicles.

The vesicle is elliptical in shape, flattened anteroposteriorly. Guelliot[1] gives 49, 18.5, and 10 mm. as its average length, breadth, and thickness. The lumpy surface of the vesicle has been compared to the convolutions of varicose veins or of the intestine. By a tedious and

[1] "Des vésicules séminales," Paris, 1883, p. 27.

delicate dissection the vesicle may be unraveled. It is a canal 10 to 15 cm. long. From this canal spring numerous small diverticula, one of which, originating near the orifice of the organ, may be almost as long as the vesicle itself. The blind end of the vesicular tube may be doubled back, so that the tube actually terminates near the orifice of the vesicle, and the fundus represents its middle.

The tube is quite as irregular within as without. Here and there the orifices of diverticula loophole the tortuous wall.

The vesicle is made up of three coats: a thin outer fibrous coat, a thick middle layer of circular and longitudinal muscular fibers, and a mucous membrane. This contains many elastic fibers. Its epithelium is cylindrical in youth, cuboidal or flattened in old age. The epithelial cells often contain granules of brownish pigment, masses of which are occasionally found in the semen. Guelliot denies the existence of special glands in the vesicle, and affirms that the epithelium is identical throughout the organ. Rehfisch recognizes vesicular glands.

The *arteries* of the vesicle are derived from the inferior vesical and the middle hemorrhoidal. The *veins* join the prostatic and lateral vesical plexus. The *lymphatics* empty into the pelvic ganglia. The *nerves* are derived from the hypogastric plexus of the sympathetic.

The *ejaculatory ducts* begin at the junction of the vas deferens and seminal vesicle. Becoming smaller and of even caliber, these ducts run obliquely forward and upward through the prostate, approaching each other until they nearly touch in the median line. Yet they are quite separate in their openings on the lips of the prostatic utricle. They are closely surrounded by a dense elastic tissue and contain a few straggling muscle fibers derived from the longitudinal muscle of the vesicle.

PHYSIOLOGY

The functions of the vesicle are three:

1. To store the secretion of the testis.
2. To dilute it.
3. To expel it into the prostatic sinus just before ejaculation.

1. Rehfisch,[1] in a detailed study of the comparative anatomy and physiology of the seminal vesicles, showed that in rats, guinea-pigs, and some other mammals, the vesicles empty by a separate duct into the urogenital sinus and at no time contain spermatozoa. But he confirmed on man De Graaf's experiment of injecting the vas deferens, showing that the vesicle fills with fluid before the ejaculatory duct is forced open. Hence it is fair to assume that the vesicle, as well as the ampulla of the vas, is a place of storage for the spermatozoa.

[1] *Deutsche med. Wochenschr.*, 1896.

2. The *secretion* of the seminal vesicle dilutes the semen and probably has some obscure function of stimulating the vitality of the spermatozoa. This secretion is albuminous, alkaline, and odorless. It contains a large proportion of mucin. Besides blood cells, leukocytes, and epithelia, the fluid contains many little hyaline pellets rarely visible to the naked eye. These bodies (sympexions, globulin körner) appear under the microscope as hyaline spheroids showing radiating lines of cleavage. They may contain masses of spermatozoa or pigment granules, and may attain a size sufficient to obstruct the ejaculatory duct.

3. The vesicle becomes distended with fluid by the accumulation of its own secretion and the influx of testicular fluid. Unless there is spermatorrhea, little or none of this fluid escapes, except during the sexual orgasm. This act occurs as follows: after a period of sexual excitement, during which the verumontanum becomes erect, the muscular coat of the vesicle and the ampulla of the vas contract peristaltically, driving the fluid into the ejaculatory duct, which, very probably, is relieved of the elastic pressure that usually occludes it by a simultaneous muscular contraction of the prostate. The semen is thus ejaculated into the prostatic sinus, where it mingles with the prostatic secretion. Thence the prostatic and urethral muscles eject the fluid by jets. Regurgitation of semen into the bladder is prevented, not by the erect verumontanum but by the force of the stream issuing from the ejaculatory ducts.

Science and experience agree that the seminal vesicles are not emptied by a single orgasm.

ANOMALIES

Anomalies of the seminal vesicles are usually part of some general genital malformation. Guelliot has analyzed and refused to accept the alleged cases of multiple seminal vesicles. When the vesicle is absent the corresponding testicle may yet be present. Extreme dilatation of the vesicles is probably always acquired.

The ejaculatory ducts may empty into the ureters instead of on the edge of the prostatic utricle. In a few cases they have been found to continue forward alongside of the urethra the whole length of that canal to the meatus.

WOUNDS OF THE VESICLE

Guelliot recognizes only one case of undoubted accidental wound of the vesicle. The patient had suffered a fracture of the ischium.

Operative wounds of the ejaculatory ducts are very frequent. The patency of the ducts is imperiled by all perineal cystotomies and prostatotomies, including lithotomy, Bottini's operation, and prostatectomy. Two results follow: inflammation (acute vesiculitis and epididymitis) possibly, obstruction probably.

Fistulae of the spermatic duct have resulted from the old-fashioned lateral lithotomy operations. The resultant spermatic fistula heals kindly unless the parts are cancerous or tuberculous.

EXAMINATION AND INFLAMMATION

(See pp. 8, 165, 176, 182.)

TUBERCULOSIS

(See p. 438.)

CYSTS

Prolonged inflammation sometimes causes gradual dilatation of the vesicles until they become two or three times their normal size and even overlap in the median line. Such cysts have only a pathological significance.

Echinococcus cysts occurring between rectum and bladder have been attributed, without convincing proof, to the vesicle.

CONCRETIONS AND CALCULI

While it is not unusual to find a number of concretions or small calculi in the vesicles of the aged, they have, as a rule, no clinical symptoms. It is only very rarely that they give rise to spermatic colic or attain a noteworthy size (Fig. 32).

Symptoms.—*Spermatic colic* may occur at the moment of ejaculation or during sleep. The pain is very sharp, colicky, in fact, and nauseating. It is centralized about an inch up the rectum, or at the neck of the bladder, and thence radiates up the posterior wall of the pelvis or to the testicles. The pain is caused by the impaction of a concretion or a mass of inspissated semen in the duct. The obstruction may be forced, and a painful and deficient emission ensue after a few moments of colic, or, if it occur without sexual sensations, during the

night, it lasts from ten to twenty minutes and then gradually dies away.

Treatment.—The hot rectal douche (p. 244) is an excellent remedy to relieve the pain and to shorten the attack. Many persons who are subject to mild attacks of nocturnal spermatic colic obtain relief by introducing a finger into the rectum and pressing upon the offending organ.

Relapses are prevented by massage of the vesicle.

MALIGNANT GROWTHS

Guelliot recorded but one authentic case of primary carcinoma of the seminal vesicle. Secondary involvement occurs from the prostate, bladder, or rectum.

CHAPTER LXV

DERANGEMENTS OF THE GENITAL FUNCTION

IMPOTENCE

Impotence is inability to accomplish the sexual act. It is a complaint not infrequently submitted to the physician; not always frankly and openly as such, but often by implication, as though it should be recognized and inquired about in answer to remote indications which the patient has scantily furnished. The physician who would meet the daily wants of his fellow-men in reference to troubles of this sort, must possess an accurate knowledge of the physiology of the sexual function and of its various derangements, and be ready to anticipate the reticence of patients; otherwise he will fail to sound many of the depths of human nature where suffering lurks—which suffering is for the most part preventable or relievable.

Impotence must be carefully distinguished from sterility, which signifies inability to beget offspring on account of defect in the semen, whether the individual can have sexual intercourse properly or not. The two are often associated in the same individual, but they may be totally distinct, as the following examples will illustrate. Thus, in the East, there are two methods of making eunuchs: either the penis is removed together with the testicles (and such a eunuch is necessarily both impotent and sterile), or the testicles alone are removed (and such a eunuch, though sterile, may be still potent, and does not bring so high a price as the eunuch who has no penis). It is a well-known fact that both animals and men, from whom the testicles have been removed after puberty, still retain sexual desires, and may have intercourse, with venereal orgasm and ejaculation, during a period of many years. A cryptorchid is not impotent, but is very apt to be sterile, and such is the case of many patients after double gonorrheal epididymitis; while, as causes of impotence without sterility, may be mentioned deformities preventing sexual intercourse, though the spermatic fluid is normal, such as exstrophy of the bladder, extreme incurvation of the penis, and hypospadias.

Impotence may be organic or functional.

ORGANIC IMPOTENCE

This is exceedingly rare in the male. Anyone who can perform the sexual act is potent. This act implies two conditions, namely, sufficient erection to make intromission possible and a subsequent seminal ejaculation.

That lack of desire before the act and pleasure during its accomplishment are not absolute essentials to sexual intercourse is exemplified by the two conditions: priapism from cantharides in which there is no desire, and yet intercourse is possible with perfect intromission and ejaculation, and certain diseases of the cord attended by more or less priapism, where intercourse followed by conception may take place, and yet the patient be unconscious at what moment ejaculation occurs.

Conditions Involving True Impotence.—1. Absence of penis. If there are healthy testicles, the patient cannot be called sterile.

2. Minute size of penis may involve impotence. That small size is only relatively a cause of impotence is evident, and that it by no means involves sterility is shown by Orfila, in a case where an action for rape was brought against a man with only a stump of a glans in place of the entire penis, by a woman who was impregnated by him. Orfila decides that impregnation may take place under these circumstances, but only through the consent of the woman, and that consequently rape is impossible. The numerous cases on record where impregnation has taken place without rupture of the hymen show that a deposit of semen within the ostium vaginae may fertilize an ovum, and such a deposit of semen *might* be accomplished by the smallest possible penis. Intromission and ejaculation might take place, and impotence, though possible, is not essential.

3. Extreme size of the penis is a relative cause of impotence.

4. Extreme epispadias and hypospadias, or incurvation, likewise involve impotence, without sterility. Slight hypospadias may, but does not necessarily, involve impotence. The semen is not properly ejaculated into the upper part of the vagina, and impregnation sometimes fails to take place on this account.

5. Large size of the prepuce, or excessively tight and narrow orifice of the same, may involve impotence, as may also any tumors or growths upon or about the penis, elephantiasis, fatty tumor, hydrocele; or neighboring deformity (faulty position of the thigh from ankylosis of hip, excess of abdominal fat, etc.), which may mechanically interfere with copulation without in the least implying sterility.

6. Very tight stricture of the urethra, especially if there be large and multiple fistulae behind it, involves impotence if the semen does not escape by ejaculation, but dribbles away after erection subsides. A similar cause of impotence exists in a vicious direction of the orifices of

the ejaculatory ducts, by which during ejaculation the semen is turned backward into the bladder and escapes afterwards with the urine. According to Grimaud de Caux, such a condition of things may be caused by the action of prostitutes, who, fearing pregnancy, watch for the moment of ejaculation, and then press forcibly upon the urethra of their partner just in front of the prostate, by inserting a finger into his rectum, thus causing the semen to be ejaculated into the bladder. A similar condition has been known to result from prolonged posterior urethritis and is not infrequent after prostatectomy. When, from these or any other causes, there is no ejaculation, the condition is known as *aspermatism*. I have known two patients who alleged complete aspermia to beget children.

7. Imperfect, irregular, or bent erections, due to inflammation, injury, or tumor of one of the erectile cylinders of the penis, may sometimes prevent intromission and entail impotence.

8. Eunuchs, and those having atrophy of both testicles, are usually impotent, always sterile.

9. Injuries or diseases of the central nervous system may cause impotence by interfering with either erection or ejaculation.

Impotence may be *symptomatic*—not to speak of the physiological impotence of childhood and old age—and then is only conditional or temporary, and usually disappears with the removal of its cause. In symptomatic impotence there is lack of erection, and often also temporary sterility. Such impotence is always associated with severe acute febrile diseases and with conditions of lowered vitality, whether due to wasting disease, to shock, or to other causes. Long-continued sexual excess, whether by masturbation or otherwise, produces impotence, though this is commonly a false impotence, an inability of the jaded body to keep pace with the lecherous mind. Finally, all drug habits—opium, tobacco, cocain, alcohol, etc.—tend to produce impotence. When a man is thoroughly drunk he is impotent; when a steady drinker, his sexual powers are always diminished, sometimes lost.

FUNCTIONAL IMPOTENCE

Functional impotence is properly defined by Hühner[1] as "that form of impotence in which there exists no gross pathological change in the structure of the sexual apparatus." It may be considered under three heads:

1. Imaginary impotence.
2. False impotence.
3. Impotence depending upon disease of the sexual organs or abuse of the sexual function; usually both together.

[1] *Medical Record*, October 23, 1915.

Imaginary Impotence.—The first class may be passed over lightly. Unhappily, there will always be among us a class of men, of splendid physique and infinite endurance, who elect to spend their lives in ignoble homage to Venus. And such men have their followers, their admirers —puny, dyspeptic, rabbit-eyed creatures—whose sole ambition is to flog their bodies on to wondrous feats of venery and bestiality. And since Nature never cast them in this mold, they come crying out because their bellies are not so big as their appetites, instead of thanking God for it.

False Impotence.—False impotence is that purely psychic condition which may result in a perfectly normal individual from sexual indifference or from such emotions as grief, joy, fright, repugnance, etc. It is only rarely that persons so afflicted consult a physician, and they can then usually be relieved by a proper interpretation of their symptoms. A second type of false impotence, however, exists in the sexual pervert whose abnormal habits have engendered a method of thought which renders normal cohabitation repulsive or impossible. Such patients require the most careful psychotherapeutic treatment which, with the help of psycho-analysis, and a sympathetic understanding of their condition, often works wonders.

Sexual Neurasthenia.—Sexual neurasthenia, inasmuch as it implies pain and discomfort, has been dealt with on page 181. But the lesions there described centering about the verumontanum and utricle form the physical basis of the great majority of cases of impotence. The patient may attribute his trouble to gonorrhea, but it is doubtless always due to some sexual aberration. In early life the dominant cause is masturbation, later excessive sexual activity of any kind, and in married life *coitus interruptus*. Ungratified sexual excitement is a cause of impotence only when carried to great lengths and resulting in prolonged erections without emission.

As a result of these conditions there may be impairment of desire, psychic impotence, disturbances of the orgasm, usually in the nature of pain, and associated with other evidences of inflammation of the verumontanum (such as painful urination, etc.). Finally, and most important, are the disturbances of erection and ejaculation. The condition begins with frequent nocturnal emissions due to hypersensibility of the sexual reflex (usually caused by verumontanitis); and premature ejaculation soon results. If the patient exercises prudence and intelligence in the management of his sexual affairs the progress of his condition may be slow or he may at any time have the wit to cure himself.

As the conditions grow worse the emission becomes so premature that it actually occurs before full erection takes place.

Functional Impotence.—In diagnosing functional impotence it is to be remembered that every case has its psychic basis, most cases a

moral and a physical one. The following suggestions will be of assistance:

1. True continence, chastity of thought as well as of act, never causes impotence.

2. Delay and lack of sensation in erection is likely to be psychic rather than due to sexual excess.

3. The intense reticence of these patients, while perfectly natural, interferes with a proper understanding of the case. Some form of psycho-analysis is often necessary to obtain all the facts, but once the physician has these in his possession he is in a position to treat the case intelligently; without the facts, he can do nothing.

4. The condition may continue to develop after its cause, e. g., masturbation, has long since stopped.

Treatment.—The treatment is threefold:

1. The Patient's Sexual Coefficient Must Be Discovered.—The sexual coefficient is the amount of sexual power with which he is endowed by Nature. Mankind at large is possessed of the notion that, although men's noses and digestions need not all be cut of the same pattern, it is to be expected that the sexual capacity of everyone should be all-embracing. Thus, while it is no disgrace to be dyspeptic about the stomach, it is to the last degree shameful to be dyspeptic about the genitals. Theoretically, such a distinction is absurd; but practically, no man is willing to brand himself a sexual laggard. In some way, by dint of enumerating emissions, copulations, masturbations, the physician must learn what ideal he can set before the patient. If a man's natural capacity for sexual congress is only once a month, it is hopeless to try and tune him up to three times a night.

2. The Patient Must Be Encouraged.—The first point of encouragement must be to depress him by bidding him look for a protracted and relapsing convalescence. Then he must be made to understand that his sexual possibilities are just so great and no greater; and that, however well he may get, overstepping his allotted bounds will call down swift retribution upon him. Finally, he must really be encouraged to feel that his malady is a functional disorder, a dyspepsia, which, like other dyspepsias, is curable, but only at the cost of a prolonged fast. He must abstain from coitus, from masturbation, from lewd companions, from obscene thoughts and things. The more thoroughly he abstains, the more certain his cure. Usually he will try to adopt halfway measures, caring more for his "pot of ale" than for body and soul together. But such a course may not be countenanced. The ideal of absolute purity must be forever set before him and, as it were, hammered into him. If a strong moral influence, as that of father, brother, or priest, can be brought to bear, so much the better.

But all these measures are frankly palliative. When a man has

once got into the habit of concentrating his whole mind upon his sexual organs, it is not to be expected that he should be entirely diverted to higher things. Chastity all can aim at, but celibacy is beyond the reach, beyond even the understanding, of the many. Hence, the proper cure for such a man, if he can be got into such a condition that he has an erection ever so rarely, is to instruct him in sexual physiology and hygiene, to acquire his confidence by sympathy, and to get him married, with the advice to attempt no intercourse, to be entirely frank and honest with his wife (who will more than equal him in timidity and ignorance), and, awaiting some morning when awaking with a vigorous erection, to accomplish coitus promptly without delay, as a matter of imperious duty. The act once accomplished, the spell is broken. He knows he is a man and his confidence in himself returns.

3. He Must Be Assisted Physically.—When possible, an entire change of scene with hard physical work presents the best opportunity for a man to get out of his old rut.

Local treatment of the urethra by instillations, urethroscopic cauterization, massage of prostate and vesicles, sounds, etc., quite empirically, as in the treatment of sexual neurasthenia (p. 204).

Hühner speaks well of bromids, 1 gm., p. c. (and 0.0025 (1/20 gr.) of strychnin in four doses, q. 2 h., immediately preceding intercourse).

STERILITY

Sterility is an inability to beget children on account of absence or imperfection of the semen.

The spermatic fluid, though ejaculated, may contain no spermatozoa (*azoöspermia*). Without enumerating all the possible causes of azoospermia, three may be especially designated:

1. Obliteration of both epididymes or both vasa by inflammation.

2. Such temporary influences as debilitating disease and mental or physical exhaustion. The latter is the cause of temporary sterility in many business men. They can impregnate their wives only after a vacation has supplied them with surplus energy. Chemical toxemias may produce the same result, and although alcoholics are famous for having large families, Simmons[1] estimates that 61 per cent of alcoholics are sterile.

3. The x-ray[2] deserves special mention. Brief exposure to this may entail brief sterility. The constant exposure to the influence of the ray to which radiographers are subjected results in a prolonged and perhaps a permanent sterility.

[1] *Deutsch. Archiv f. klin. Med.*, 1898, lxi, 412.

[2] Cf. Brown and Osgood, *Trans. Am. Assn. G.-U. Surg.*, 1907, ii, 365.

4. Inflammation of the prostate and vesicles. If the inflammation is severe the spermatozoa may be killed in transit, but even a mild catarrh may so alter the qualities of these secretions as to render the spermatozoa infertile.

Oligospermia is a rare and apparently congenital condition in which the semen instead of swarming with spermatozoa contains but few of these. They are usually deformed. Such a condition entails sterility just as much as does azoöspermia.

Aspermia means absence of ejaculation owing to defect or deformity or scar about the orifices of the ejaculatory ducts; these project the semen backward into the bladder instead of outward along the urethra. The patient recognizes no ejaculation, but usually there is a slight seepage from the meatus and such patients are by no means inevitably sterile.

Diagnosis.—The diagnosis of sterility is a much more complex problem than the above paragraphs suggest for the problem includes, not only the question of masculine, but also that of feminine sterility. Moreover sterility is often relative. The diagnosis of sterility, due to such gross lesions as azoöspermia, oligospermia or aspermia, is readily accomplished by the examination of a condom specimen. The difficult problem is that in which both man and woman are apparently normal though their union remains infertile. *Careful microscopic examination of a condom specimen of semen is the first step in diagnosis.* The chief information obtained by such an examination is the number of spermatozoa. If these are very numerous the semen is doubtless fertile even though many of the spermatozoa are deformed. Indeed it is usually a waste of time to endeavor to estimate the motility of the spermatozoa in a condom specimen. This can only be fairly studied in a specimen obtained by massage of the seminal vesicles (and unfortunately massage does not always expel the spermatozoa) or by an examination of the secretions in the woman's vagina a few hours after coitus. Reynolds,[1] basing his work on that of Hühner, comes to the following conclusions:

1. When the spermatozoa are abundant in number, normal in form and appearance, furnished with long cilia and capable of rapid movement through the semen the male is satisfactorily fertile.

2. When normal spermatozoa are killed or lose vitality overrapidly in the secretions of the individual woman the chemicophysiologic character of her secretions furnishes an effective cause of sterility.

3. The alterations in a secretion which make it fatal to the spermatozoön may be localized in the vagina, in the cervix, in the body of the uterus, or in one or both tubes; and any one of these alterations may exist with normal secretions above it; but an alteration in the secreting surface in any of these localities

[1] *Jour. A. M. A.*, 1915, lxv, 1151.

usually vitiates all the secretions below it, probably by their necessary admixture.

4. When the spermatozoa are observed to penetrate without apparent loss of vitality to the fundus of the uterus and to survive there for a normal length of time, deficient quality of the ova may be considered the probable cause of the sterility.

Throughout the management of every case of sterility it must be remembered that the failure is the failure not of one individual, but of a couple, and that the condition of both partners must be studied.

For the performance of the Hühner test[1] we must ask to see the woman as soon as possible after coitus has taken place. She may come to the office for this examination, since it is only very exceptionally, if ever, that the vagina does not contain sufficient spermatozoa for this test even after she has walked about for some time. With a normal vaginal secretion the spermatozoa should show active motility in the vagina for about an hour and sometimes much longer, but if circumstances permit it is desirable that the patient should be seen within half an hour of coitus. A specimen of the vaginal mucus is taken by a sterile platinum wire from the culdesac, exposed by a speculum, and this examination may be repeated if desired, whenever convenience permits, until the spermatozoa are found to have lost their activity. A specimen of the cervical mucus is next obtained in the same way, after the surface of the cervix has first been carefully wiped clean of semen by the repeated use of cotton swabs (no antiseptic should be used). With a normal cervical secretion and a normal os a few spermatozoa will usually be found in the lower part of the cervical cavity almost immediately after coitus, but will appear there in larger numbers at the end of half an hour to an hour. They are never so numerous here as in the vagina, but under normal circumstances, at the end of an hour, there should be several actively moving spermatozoa in each slide from the cervical mucus. The greatest care should be used to avoid the infliction of any trauma in the examination of the cervical cavity, since overthoroughness here may readily vitiate the use of the remaining portion of the test at that sitting.

When the cervical cavity has not been unduly disturbed, when the spermatozoa are of full vitality, and when the secretions of the woman are normal throughout, an examination of the secretions of the cavity of the uterine body should disclose the presence of a few actively motile spermatozoa in the uterine mucus at the end of from two to three or four hours. This examination must, however, be made with a specially devised syringe, since the platinum loop can neither be introduced with certainty to the fundus nor made to retain the uterine mucus during its withdrawal from the cervix. Even with the use of a syringe it is difficult to be absolutely sure that spermatozoa which are observed in the fluid withdrawn from the uterus are not due to an admixture from the cervix, but if the piston is not withdrawn until the tip of the syringe is well up in the uterine cavity, if the outside of the syringe is carefully wiped after withdrawal, if it is properly designed, and especially if the spermatozoa are found several times in succession, their probable location in the uterine mucus can be predicated. In some cases it will be found that actively motile spermatozoa have disappeared from the cervix after the lapse of a number of hours but are still found in the uterine mucus. In these cases the test is practically complete.

The saddest commentary upon the prevalent state of the medical mind in reference to the diagnosis of sterility is reported by

[1] *Urol and Cutan. Review*, 1914, xvii, No. 11; also "Sterility," 1913.

Barney.[1] He collected statistics from a large public hospital on 108 women who were diagnosed as sterile; 74 of them were actually operated upon, or advised to be operated upon, and yet in only 5 of the whole number was the husband's semen examined.

Treatment.—Ten per cent of sterility is said to be due to the male, and it is only with the treatment of sterility in the male that we shall concern ourselves. I can recall only three classes of cases that have consulted me:

1. Aspermia after operation is likely to be only temporary, or at worst partial. I have twice tried to correct it by operation, but have not succeeded. It is, as above stated, not an inevitable cause of sterility.

2. Azoöspermia due to alcohol or overwork. Cases of the latter sort are, I believe, not infrequent. I have twice seen impregnation follow a vacation in Europe; one of these couples had been married five years, the other twenty. In both the semen was apparently normal while the husbands were at work, and the wives had been duly and vainly mutilated by the gynecologist.

3. Azoöspermia, due to bilateral gonorrheal epididymitis. For these the proper treatment is the Martin operation; without it there is no hope, with it there is a small prospect (perhaps 20 per cent), of cure.

I have never seen a case in which the vitality of the semen appeared to be interfered with by suppuration in the prostate or seminal vesicles. Many persons with chronic prostatitis and seminal vesiculitis have all the children they want. Oligospermia seems a more incurable condition than azoöspermia, for in the former case the deficiency is probably congenital, though Martin regards it as a partial obstruction.

MASTURBATION

Self-abuse is the production upon one's self of the venereal orgasm. The term masturbation signifies that an orgasm is produced by means of friction with the hand. Masturbation is not a malady. It does not necessarily produce disease unless carried to excess. Its practice is not confined to man. Monkeys are often masturbators; bears have the same habit; goats, making use of the mouth, indulge in it; turkeys sometimes practice it. In the human being it is practiced by both sexes at all ages, females being less addicted to it than males. The majority of women have little passion, and suffer the first approaches of a lover or husband largely as a matter of complaisance. Undoubtedly there are numerous exceptions to this rule, but still a rule it is that the female, naturally

[1] *Boston Med. & Surg. Jour.*, 1914, clxx, 943.

modest, retiring, refined, learns what passion is only as the result of experience. With the male it is different. His passion is natural. He has erections while yet a child, and sexual yearnings long before puberty. Rarely does a boy escape initiation into forbidden pleasures by his schoolfellows or his elders, and, though he escapes these, he is still very likely, when handling himself during erection, to find the sensation agreeable, and to go on, really ignorant of what he is doing, until he has become a confirmed masturbator. Male babies are sometimes handled by their nurses to keep them quiet, a practice which is certain to beget the habit even in the earliest years of life. Stone in the bladder, irritation of the prepuce from retained smegma, ascarides, etc., lead a child to handle himself, and end in masturbation, if long continued; indeed, there are so many causes, natural and unnatural, why a boy should masturbate that few escape. But the most common cause is instruction received from other boys at school.

Self-abuse is not confined to youth; middle and old age are not free from it.

It may be safely assumed that a large proportion of mankind have masturbated more or less at some period in their lives, and it is equally safe to assert that at least 90 per cent of such masturbators are not physically injured by the habit. If carried to excess, sexual indulgence in the natural way will produce evil effects, yet sexual intercourse is not only harmless, but even beneficial in moderation, as it can be only in the married state. It is not the loss of seminal fluid which is of the first importance in producing disease from sexual excess, but the nervous shock of the oft-repeated orgasm. Babies and young children lose no seminal fluid, women have none to lose; yet, in all of these, evil results follow excess as certainly as they do in the male after puberty. It is probable that any succession of nervous shocks as sharp and decisive as the sexual orgasm, even although purely intellectual, such as joy or fear, would shatter the vitality and nervous tone of an individual as much as masturbation.

Such writers as Lallemand, Acton, Belliol, make too much of the solitary vice, while quacks find here the largest and most lucrative field for their nostrums. These men scatter their books and circulars broadcast over the land, and often, under alluring titles, thrust them within the eager grasp of the young, the inexperienced, the hypochondriacal, the nervous, overworked, unmarried youth, whose sexual needs, stimulated by his impure thoughts, find no adequate relief. Their tenets find ample faith and ready acceptance in the ingenuous mind, and errors are implanted which years of sober after-thought and experience, aided by the physician's careful and conscientious advice, are scarcely able to eradicate.

The use of tobacco, alcohol, and, it might be added, tea, is as wide-

spread as the habit of masturbation; and each of these, or certainly the first two habits, probably inflicts as much injury upon the human race as does the secret vice. Yet who would affirm that every man who smoked would have headache, dyspepsia, heartburn, neuralgia, intermitting pulse, or would become thin, depressed, nervous, sleepless —all of which effects may be produced by an excess of tobacco; or that another who drank liquor would necessarily have delirium tremens, cirrhosis of the liver and kidney, and die with ascites and Bright's disease? As with whisky and tobacco, so it is with masturbation carried to excess. Masturbation may contribute in producing the most serious results, among which idiocy, insanity, epilepsy, dementia, physical prostration, hypochondria, impotence, and sterility are prominent; but in such it will be found that some mental deficiency was the fundamental difficulty, masturbation but one of its expressions. Hence it is evident that, while the intelligent physician must recognize the physical evils masturbation may produce, he should boldly oppose himself to that sickly sentimentality which shrouds in mystery one of the failings of our physical nature because it involves the sexual function, and should try to face the subject honestly and to handle it as a scientific problem.

The majority of mankind who indulge in masturbation do so just before and after puberty. At first most of them are ignorant that they are harming themselves, but they soon find it out by one means or another, and then sooner or later give it up. The longer and the more frequently they yield to the vicious habit the stronger does its hold become, so that in case they escape the mental and physical disorders to which excessive venery in extreme cases may give rise, still they may pay the penalty of excess by some diminution of vigor in after-life, by upsetting their sexual hygiene, and by establishing sexual necessities which they find it difficult to satisfy; and, finally, they may continue on through life victims to a perverted sexual sense, shunning women, from whom they aver that they derive no pleasure, totally wrecked as to their *morale,* hypochondriacal, and suffering from all sorts of functional distress, physical and intellectual, real and fancied.

The chief reason why so much is said of venereal excess by masturbation, and so little of sexual excess in the natural way is that the former is so much more common, and not that the act itself is physically more harmful. The solitary vice, as it is aptly styled, may be practiced on all occasions. On the other hand, sexual intercourse requires the consent of two individuals and opportunities which are comparatively hard to find.

In married life excess is the exception; sexual hygiene is more apt to be correct, man is in his natural condition. Other emotions enter largely into his daily life, and it is rare that a man happily married complains of any disorder of the genito-urinary system, except those of

a purely physical nature. On the other hand, the old rounder, who flatters himself upon the number of women he has ruined, but lays the blame upon Dame Nature, is usually a masturbator and, not infrequently, a pervert.

Symptoms.—A young child who has been taught to masturbate will be seen constantly at work at his genitals, and observed to have erections with unnatural frequency. No further signs are needed. Such children are fretful, peevish, thin, nervous, excitable, sleep badly, and have a haggard look.

Boys who masturbate to excess usually incline to melancholy broodings, to staying apart and reading rather than to joining their companions at play. Their palms are apt to be cold and moist. They lose the innocent frankness of youth.

The young man is overshy, unambitious, he shrinks from a steady gaze, blushes readily, and seems to be conscious of having done something unmanly.

Adult masturbators often show no sign of the habit, though they are apt to be cowardly, mean-spirited, poor specimens of humanity. But it is rare for adults to practice masturbation to great excess, and, if they suffer from any of the supposed evil consequences of the habit, it is either on account of excess in earlier life, of imperfect sexual hygiene, or of irregularly gratified sexual desire. Their symptoms assume a multiplicity of expression, and are generally hypochondriacal, and manifestly not entirely dependent upon masturbation; for the same symptoms are very common in patients who do not masturbate. As to atrophy of the genitals, varicocele, etc., these are not due to masturbation. Masturbation is a symptom, rather than a cause, of insanity.

The physical damage done by masturbation (or any other form of sexual excess) is confined to the internal genitals. Its most patent expression is verumontanitis (cf. Hühner [1]).

The foregoing remarks are not intended to palliate in the least degree the baseness of the practice of self-abuse, or to deny that lack of physical and sexual vigor, spermatorrhea, neuralgia of the urethra, etc., may be caused by its excessive indulgence; but they are intended to combat the prevalent idea that very few men indulge in the secret vice, and that all who do so suffer; and they are also intended to advance the proposition that in the vast majority of instances masturbation does little harm to the individual, except in regard to his *morale*. It unmans him, makes him untrue to himself, and cowardly; and most sensible boys find this out before a great while, and give up the practice, which they feel to be sapping their manhood and self-esteem.

Treatment.—It is infinitely better that a boy should never mastur-

[1] *N. Y. Med. Jour.*, Feb. 17, 1912.

bate if he can be prevented. Prophylactic instruction may save him. No instructor can equal a parent, whose moral influence outweighs all consideration of amateurishness. Every child has a right to know the essentials of sexual life. Indeed every boy, at least, will learn from an evil source all he fails to learn from a pure one.

The parent's chief duties are two, viz., to answer all questions with absolute frankness (for they are asked in that mood), and to warn the child of approaching phenomena of emissions, etc., as well as of the need of keeping his hands off his own genitals and those of others.

In the case of babies who do not do well, nurses should be watched and discharged if they are found handling the child. If the infant has already acquired the habit, his hands must be tied when he sleeps, and at all other times he must be watched until he grows out of the habit. Circumcision often helps to check masturbation whether of boy or girl. Boys should always be made to sleep alone, never allowed to consort secretly with any other one boy. All close intimacies between boys of different ages should be broken up, and, on the appearance of any of the signs of masturbation, a close watch should be maintained.

In most cases it is not good policy to ask a boy if he fingers his privates. He will be pretty sure to say no, and then to tell other lies to substantiate the first. To assume the fact after a careful study of the case is the safest course, and the boy, thrown off his guard by the statement that he does masturbate, will rarely deny it, or will do so in such a lame manner or with such overpositiveness as to convict himself. Finally, when the patient has confessed his folly, it is not wise to terrify him out of his habit by brilliant and exaggerated statements of the possible misery he may bring upon himself if he does not desist. This is appealing to a base motive, and, although sometimes successful, it is often inadequate to the proposed end, for a healthy boy cannot realize what it means to be sick; he cannot understand it, and consequently is not afraid of it. The method of treatment that is most effective, but requires the most force to carry out, is to elevate the boy out of his bad habit, to shame him, to make a man of him, to reason with him, and to talk to him honestly and openly, without reserve or mysticism.

When a man comes complaining of the results of masturbation, an attentive study of the symptoms will prove his disease to be hypochondria, and his malady ungratified sexual desire, often with congestion of the verumontanum. His training should consist in encouragement to continence, with absolute purity of thought, and subsequently marriage, to regulate his sexual hygiene. After marriage we hear no further complaint from these cases, always provided there is really nothing more than functional derangement at the bottom of the patient's complaint, as is the case in the vast majority of instances.

Treatment of the inflamed prostate and vesicles by massage and of the verumontanum by instillations or urethroscopic applications is an essential part of the treatment of the adult.

Medicines are of little or no value; camphor, bromids, or lupulin may be given as placebos, but it is doubtful if they have any efficacy. Cold sponge-baths, outdoor sports, physical fatigue, sleeping in a cool room on a hard bed with a light covering, are all useful; eating lightly at night, not retiring until very sleepy and rising immediately on waking in the morning, are powerful assistants in breaking up the habit.

POLLUTION

Pollution is a term applied to involuntary emissions of semen in ejaculation, attended by a more or less marked venereal orgasm. Pollutions are nocturnal or diurnal.

NOCTURNAL POLLUTIONS

Nocturnal pollutions are exceedingly common. They usually accompany an erotic dream, and the patient wakes just as the ejaculation is occurring. When sleep is profound, the patient may not wake, or, if he does, he forgets his dreams, so that the sensation of pleasure accompanying ejaculation is faint and forgotten. Occasional nocturnal emissions are entirely natural and by no means a sign of disease. Their frequency compatible with health varies with the purity of mind and the sexual vigor of the patient. A man who is happily married rarely has nocturnal emissions while living with his wife, but, if he leaves her for several weeks, it is natural that there should be a formation and collection of semen which, distending the seminal vesicles, excites erotic fancies and escapes at the conclusion of a dream. Any man suffering from ungratified sexual desire is normally in a condition demanding relief for his overdistended seminal vesicles and, if that relief be not afforded in some other way, it comes spontaneously during sleep. This is all the more certain to be the case if he has established a habit of excessive sexual intercourse, or masturbation. Occasionally nocturnal emissions may be overfrequent, and indicate a condition of irritation in the deep urethra which requires treatment.

Treatment.—When emissions do not exceed one a week they should be disregarded, and attempts made only to purify the patient's thoughts, to elevate his physical tone, and if possible to get him happily married. The patient should exercise and develop his muscular system. He should endeavor to tire himself out by physical work so as to sleep soundly. Locally, cold baths and cold douches are useful. He should

sleep on a hard bed, lightly covered. The stomach should not be full on retiring. Most patients have involuntary emissions toward morning, and waking, find themselves lying on their backs. This position, with the bladder somewhat distended, tends to beget erection, and, by avoiding it, pollution may be escaped. This end may be accomplished by tying a towel round the waist on retiring, with a hard knot in the back of the spine. When the patient lies upon this knot it awakens him.

If these measures fail, or if the emissions recur so frequently as really to do harm, local treatment for vesiculitis, prostatitis or verumontanitis is required.

From time to time different mechanical devices appear for treating pollution, their object being either to prevent the patient from handling himself during sleep or to awaken him before emission when he gets an erection. I believe them valueless and as likely to do harm as good, by keeping the patient's mind concentrated upon his malady and leading him to attach too much importance to the physical act of emission.

DIURNAL POLLUTION

Diurnal pollution is rare. Some impressionable patients acquire so intense a prostatic irritability from venereal excess that the sight or thought of certain women or the lightest friction upon the glans penis will produce ejaculation. Such injuries to the spine as are caused by the garrote and the gallows commonly cause ejaculation; and sexual perverts find in shoes, hats, odors, and various abominations sufficient cause for pollution.

PRIAPISM

Priapism is a condition of prolonged erection independent of the will or emotion of the patient. Such erections may be transitory, in which case they are usually due to some local inflammation or to cerebral or spinal disease (e. g., tabes). But in severe cases the priapism may be of very long duration. Hinman[1] distinguishes the cases due to nervous causes, and those due to local mechanical causes. Among the former 3 were due to peripheral irritation (phimosis, fissure in ano); 4 were toxic, 3 due to cantharides and 1 to diabetes; 5 due to nasal polypi and cured by their removal, 13 to fracture of the spine, 1 to myelitis, and another to tumor of the spinal cord.

Among the cases due to mechanical cause, 64 followed sexual excess and in 55 of these there was thrombosis of the corpora cavernosa, 6 other cases of thrombosis followed a systemic infection, in 2 cases there was

[1] *Annals of Surgery*, December, 1914.

infiltration with neoplasm, while 2 others were attributed to angioneurosis. Injury produced the thrombosis in 7 cases; "45 cases showed a definite relationship to leukemia."

Hinman states that priapism is most common between the twentieth and the fiftieth years, and that it may continue for from a few hours to two years. The nervous cases of functional origin are usually repetitious and brief. Pain may be absent or severe. There may be some disturbance of urination; sexual desire is usually absent. Many of the cases have gotten well spontaneously or by treatment of a recognized etiological factor. Hinman suggests operative relief by division or injection of the internal pudic nerve, by ligation of the dorsal arteries, or by dividing the ischiocavernosi muscles. For priapism due to thrombosis of the corpora cavernosa incision has been employed with success in 31 out of 33 cases. Hinman suggests that incision in one corpus is likely to drain both, since the vascular anastomosis is free.

CHAPTER LXVI

DISEASES OF THE PENIS—ANATOMY—ANOMALIES—INJURIES—INFLAMMATIONS

ANATOMY

The penis is a genital organ. Its urinary function is purely secondary. It is conformed anatomically to subserve the genital function. In the adult it measures, when at rest, from the root of the scrotum to the meatus urinarius, from 6 to 10 cm. ($2\frac{1}{2}$ to 4 inches); when erect, from 12 to 17 cm. (5 to 7 inches). It consists essentially of three segments—the two corpora cavernosa, lying together like the barrels of a gun, and the corpus spongiosum, like the ramrod, beneath them (Fig. 133), the whole surrounded by integument.

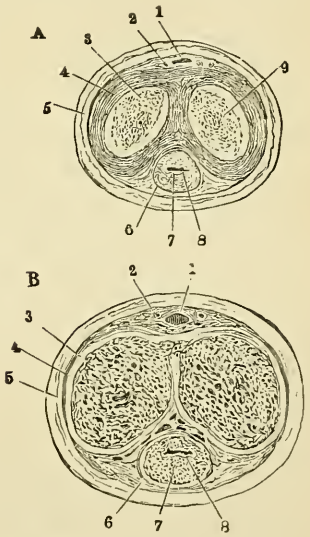


Fig. 133.—Transverse Sections of Penis (Cruveilhier). A, flaccid. B, in erection. 1, 2, dorsal vein and artery; 3, corpora cavernosa; 4, tunica albuginea; 5, integument; 6, tunica albuginea of corpus spongiosum; 7, erectile tissue; 8, urethra.

The Corpora Cavernosa.—The corpora cavernosa arise on each side from the tuberosities and ascending rami of the ischium. They come together under the symphysis pubis, and continue side by side, forming the main bulk of the penis. They terminate anteriorly in a conical extremity, over which the glans penis (the terminal expansion of the corpus spongiosum) fits like a cap. There is no vascular communication between the corpora cavernosa and the glans penis, or the corpus spongiosum.

The corpora cavernosa are surrounded by fibrous sheaths which are so dense and strong that they will support the weight of the cadaver.[1] These sheaths are plentifully supplied with elastic fibers. The anterior portion of the partition between the corpora cavernosa is perforated by numerous apertures, to insure symmetrical erection. The

[1] Cruveilhier, "Traité d'anatomie descriptive," Paris, 1865, ii, I, 386.

tissue proper of the corpora cavernosa consists of large venous spaces, known as spongy or erectile.

The Corpus Spongiosum.—The corpus spongiosum urethrae is also composed of erectile tissue. It surrounds all that portion of the urethra lying in front of the triangular ligament, anteriorly forming the glans penis, which caps the conical extremity of the corpora cavernosa, posteriorly terminating in the bulb, which lies just in front of the triangular ligament in the angle of the converging corpora cavernosa and below the urethra.

The Glans.—The glans penis (Fig. 13) is covered by a semimucous membrane endowed with peculiar sensibility, especially around the raised posterior border—the corona glandis. The epithelium covering the glans is fine, the papillae minute, the sebaceous glands (of Tyson) large and numerous, and most plentiful about the frenum. These glands secrete the white material (smegma) that collects behind the corona. The function of the glans penis is to furnish a soft-skinned expansion for the distribution of the terminal filaments of the nerves of sexual sensibility.

Muscular Action.—One important function of the corpus spongiosum is acquired through its bulb—namely, that of assisting in the expulsion of the last drops of urine or semen from the urethra. The prostate, the levator ani, and the deep urethral muscles—especially the compressor urethrae—contract upon the fluid remaining in the canal after micturition in a spasmodic "piston-stroke." This forces the last few drops beyond the bulb of the urethra. Now the fibers of the accelerator urinae surrounding the bulb and adjacent portions of the corpus cavernosum contract, and drive the blood contained in the areolae of the bulb forward along the corpus spongiosum, distending that body, and thus bringing the walls of the urethra more closely into contact in a progressive wave. If there is organic stricture the last few drops of urine do not escape promptly, but dribble away; for the scar tissue which constitutes stricture obliterates the areolae of the erectile tissue and thus obstructs the free passage of the wave of blood along the corpus spongiosum.

Fascia.—The three erectile bodies which have been briefly described are surrounded by the fascial sheath of the penis. This fascia (called Buck's fascia) arises from the symphysis pubis by a triangular bundle of fibers, the suspensory ligament of the penis, and from the pubic rami at the attachment of the anterior layer of the triangular ligament. Thence it runs forward, surrounding the corpora cavernosa and the corpus spongiosum in two separate compartments. The lower plane of this fascia is in its posterior part identical with the deep layer of the perineal fascia. The cavity of Buck's fascia is bounded anteriorly by the base of the glans penis and posteriorly by the triangular ligament.

Hence peri-urethral cellulitis and extravasation are habitually confined within these limits for an indefinite time, unless at the root of the penis where the fascia blends with that covering the pubes, and leaves a loophole of escape into the subcutaneous tissue of the abdominal wall.

Vessels.—The lymphatics and veins of the penis run along the dorsum, and receive in their course branches from the corpus spongiosum. The lymphatics lead mainly to glands lying along and above Poupart's ligament on each side. The arteries arise from the internal pudics.

Connective Tissue.—The connective tissue between the skin and Buck's fascia is very loose and elastic, and, like that of the eyelids, does not contain fat.

Skin.—The skin of the penis, except that it tends to become pigmented after puberty, does not differ essentially from ordinary integument. Over the glans penis it folds back upon itself, forming a nonadherent sheath for the glans (the prepuce), evidently intended to preserve the delicate sensibility of this portion of the member.

The Prepuce.—The prepuce is composed of two layers, a cutaneous (external) and a more delicate semimucous (internal). The point of junction of these two is called the orifice of the prepuce. Between these layers is a very loose and elastic connective tissue, without fat, which permits the two surfaces to be entirely separated from each other, and the prepuce effaced, by drawing back the integument of the penis until the glans is entirely uncovered. The mucous layer of the prepuce is supplied with glands (of Tyson). It is much less elastic than the cutaneous layer.

The prepuce is attached to the lower angle of the meatus urinarius by a triangular fold of mucous membrane called the frenum preputii—analogous to the frenum linguae. The frenum contains a small artery.

ANOMALIES OF THE PENIS

Deformities of the urethra are described on p. 543.

Double Penis.—Double penis is excessively rare. It is analogous to double uterus and vagina in the female, but by no means so common. Undoubtedly it is not so rare as the records of surgery imply, for the existence of this deformity naturally leads the patient to shun observation; and, as the defect is not necessarily accompanied by any injurious symptoms, he does not voluntarily subject himself to the inspection of a physician. Hence the cases usually reported, such as those of Hart[1] and Gorre,[2] accompany grosser malformations of fetal inclusion. The case reported

[1] *Lancet*, 1866, i, 71.

[2] *Compt. rend. de l'Acad. des Sciences*, 1844.

in the first edition of this treatise [1] is a notable exception. Similar ones are reported by Drs. Alan P. Smith,[2] J. Lorthior,[3] and Carl Beck.[4]

Smith's patient had a stone in one of his bladders, was cut and cured. He could urinate from either bladder at will.

Torsion of the Penis.—With epispadias and hypospadias the penis may be more or less completely twisted upon itself. Jacobson[5] has collected a number of cases. In Caddy's[6] case the torsion was unaccompanied by any urethral defect.

Absence of Penis.—The various amputations of the penis, surgical, traumatic, or gangrenous, do not concern us here. The congenital deformity is a rare one, and usually unaccompanied by any faulty development of the testicles or of other parts of the body. The scrotum, however, is usually small and may be bifid. In either case the external genitals closely resemble those of a woman. This is male pseudohermaphroditism. The line of pubic hair is said to be an infallible sign of the sex of such a person if an adult. If a female, the upper border of the hair forms a transverse line across the hypogastrium, while the hair of the male rises up in a curved line toward the umbilicus.

The urethra opens in the median perineal raphe or on the anterior rectal wall. In the latter case there is danger of ascending infection (Matthews[7]). Harris[8] collected 6 cases, including 1 of his own, omitting 2, Révolat's[9] and Wright's.[10] More recently Preston[11] has reported a case.

Apparent Absence of Penis.—Congenital dislocation or apparent absence of the penis exists when the penis, lacking its proper sheath of skin, lies buried beneath the integument of the abdomen, thigh, or scrotum. Boutelier[12] reports such a case. Under the skin above the scrotum a movable body was felt, liberated by incision, and discovered to be the penis. Another case, reported by J. Murphy,[13] would seem to be rather a penile adhesion to the hypogastrium, for the child could urinate through a hole in the lower part of the abdomen. The *treatment* of such a condition implies the immediate liberation of the incar-

[1] Case I, Van Buren and Keyes.

[2] *Trans Med. and Chir., Faculty of Maryland,* April, 1878.

[3] *Centralbl. f. d. Krankh. d. Harn. u. Sex. Org.,* 1901, xii, 381.

[4] *Med. News,* 1901, lxxix, 451.

[5] "Diseases of the Male Organs of Generation," 1892, p. 612.

[6] *Lancet,* 1894, ii, 634.

[7] *Phila. Med. Jour.,* 1898, i, 71.

[8] *Amer. Practitioner and News,* 1894, xvii, 27.

[9] *J. de Sédillot,* xxvii, 370; Demarquay, *Maladies chir. du pénis,* Paris, 1879, p. 538.

[10] Ashby and Wright, "Diseases of Children," p. 531.

[11] *Med. Record,* 1898, liv, 315.

[12] *Union méd. de la Seine infér.,* 1875, xi, 27.

[13] *Brit. Med. Jour.,* 1885, ii, 62.

cerated member to avoid urinary infiltration. In this emergency any method of covering the denuded penis with skin may be employed, the simpler the better, leaving until later years the task of affording a more satisfactory envelope to the organ.

Congenital incurvation of the penis and scrotal concealment of that organ occur as phenomena accessory to hypospadias, and will be considered as such.

Hermaphroditism.[1]—Accepting Klebs's definition of true hermaphroditism—viz., the existence of dissimilar genital glands (i. e., at least one testis and one ovary) in one individual—there is still some doubt whether any such individual has existed. Dr. Blacker and Mr. Lawrence [2] maintain the positive side of the question, and find in the literature foundation for their belief. In no case has it been recorded that the person was, functionally, both male and female, producing both spermatozoa and ova. On the contrary, as a general rule they are sexually neuter. These true hermaphrodites resemble clinically the pseudo-hermaphrodites—persons whose sex can with difficulty be determined—and they sometimes come to the surgeon asking him to make them distinctively male or female, whichever he may deem more appropriate. In deciding such a question, if the external genitals are quite indeterminate—as they often are—the chief characteristics to be considered are the shape of skeleton, the disposition of the superficial fat, the growth of hair, facial and pubic (see above), the voice and the shape of the larynx, and, finally, the sexual sentiments of the individual. The process of "making a man of him" or "a woman of her" may be long and tedious, but may prove successful, as in a case reported by Gruber,[3] in which amputation of the hypertrophied clitoris, posterior colpotomy to enlarge the rudimentary vagina, and electric epilation of the facial hair sufficed to establish the external female characteristics.

ACCIDENTS TO THE PENIS AS A WHOLE

Wounds.—The penis is liable to be wounded by accident or by design. In the latter case insanity, or the melancholy depression produced by masturbation, induces the patient to mutilate himself; or the injury may be inflicted by a jealous woman.

Superficial cuts are unimportant, but wounds extending through the sheaths of the corpora cavernosa may give rise to troublesome, possibly fatal, hemorrhage, while the cicatrices left after healing may distort the penis and render erection imperfect and painful.

[1] Cf. Hart, *Edinb. Med. Jour.*, 1914, xiii, 295.

[2] *Trans. Obstet. Soc.*, Lond., 1896, xxxviii, 265.

[3] *Centralbl. f. d. ges. Therap.*, Wien, 1897, xv, 385.

Treatment.—Cleanse the wound. Endeavor to obtain primary union by immediate suture. Introduce the sutures just deep enough to hold the fibrous sheath. Employ moderate pressure in dressing. Erections, which are sure to occur, since the local inflammation induces a flux of blood, retard healing.

Even in cases seemingly desperate, where the penis has been almost wholly severed from the body, an attempt should be made to save it. A remarkable success in a case of this sort, where the whole penis was severed except a portion of one corpus cavernosum, is related by Artaud.[1] Erectile power is not regained after such a recovery.

Contusions.—The escape of blood under the skin after superficial contusions of the penis is often excessive, on account of the laxity of the connective tissue and the large size of the superficial veins. Deeper contusions give rise to localized swelling from circumscribed effusion of blood. This swelling fluctuates and deforms the penis more or less, sometimes causing it to deviate when erect. Inflammation of the corpora cavernosa may result, terminating in suppuration or gangrene. Severe contusions involving the urethra may lead to infiltration of urine and urethral fistula.

The introduction of the penis into a ring is a classical accident. The penis swells, the patient is ashamed to seek relief, and serious inflammatory mischief—even gangrene, urinary fistula—may ensue. Guillot in such a case conceived the happy idea of dissolving the ring, which was of gold, in a bath of mercury. Demarquay [2] narrates many curious instances of a similar character.

Subcutaneous hemorrhage may be controlled by the application of cold and pressure, with due regard for the possibility of sloughing if the treatment is overdone. Later, simple pressure to promote absorption will suffice, or the clots may be evacuated through an incision made under local anesthesia with the usual aseptic precautions. If gangrene occur, the penis should be kept absolutely dry and clean by applying a mildly antiseptic powder and a gauze dressing. The gangrenous tissue may be removed piecemeal, after which the gaps may be filled in by skin-grafting or by a plastic operation.

Injuries involving the urethra are described on p. 524.

Fracture of the Penis.—When the fibrous sheaths of the corpora cavernosa are ruptured by sudden forcible flexion of the erect penis, a sort of fracture of the member is produced, with extensive extravasation of blood, sometimes amounting to traumatic aneurysm. Valentine Mott [3] reported two interesting cases of this accident, where the only treatment employed was rest and cold locally applied. Both re-

[1] *Bull. de la Soc. de Chir.*, vii, p. 451.

[2] "Maladies chir. du pénis," Paris, 1877.

[3] *Trans. of the N. Y. Acad. of Med.*, vol. 1, Part I, 1851, p. 99.

covered with a useful organ and no deformity. Demarquay has cited many others.

Treatment.—A catheter is passed into the bladder to insure the patulousness of the urethra. Upon this the penis is bandaged and an ice cap applied. If the pressure proves unbearable or if gangrene, extravasation, or cellulitis threaten, the clots must be evacuated and the bleeding checked by suture. The urine should be diverted through a hypogastric opening.

After recovery an indurated spot may remain permanently to mark the site of the injury, perhaps resulting in priapism or stricture.

Fracture of Corpus Spongiosum.—Fracture of the corpus spongiosum is generally occasioned by "breaking the chordee" in gonorrhea. The inflamed tissue gives way, yielding urethral hemorrhage as an immediate and traumatic stricture as a remote result.

The healthy corpus spongiosum may be fractured during erection. Dittel[1] gives one such case. My father has seen another.[2]

Dislocation of the Penis.—When the integument of the penis is violently dragged upon, as, for instance, when the clothes are caught and torn away upon a revolving wheel, the entire penis may be shot out of its investing cutaneous sheath and lodged in the scrotum, the perineum, the groin, or under the integument of the abdomen. In such cases, the semimucous membrane of the prepuce gives way either at the preputial orifice or just behind the corona. A number of instances of this curious luxation have been recorded.[3] The penile injury is usually not discovered until retention of urine or the passage of urine by some opening at a distance from the preputial orifice directs attention to the contused genitals, when the penis is found to be only a sheath of integument containing clotted blood. Sometimes it has been difficult to find the penis at all; but an intelligent search will always reveal it, and then the surgeon's obvious duty is to replace it in its sheath, incising the integument about its root as far as may be necessary to attain the desired result.

In dislocation, the urethra is often ruptured low down, and, after the organ has been replaced in its sheath, operation for urethral rupture may be called for.

In one case, a six-year-old child, Nélaton reduced a dislocated penis through the preputial orifice by means of an aneurysm needle, assisting its hook action by external manipulation.

[1] *Wien. med. Blätter,* 1885, Nr. 2.

[2] Van Buren and Keyes, 1st ed., p. 7.

[3] Cf. Goldsmith, *Lancet,* 1898, ii, 387.

CUTANEOUS AND MUCOCUTANEOUS AFFECTIONS OF THE PENIS

Many common skin diseases involve the skin of the penis as well as other integumentary parts. As a rule, they present no special characteristics and require no comment here. *Venereal sores,* true chancre and chancroid, are common, as also are soft venereal warts. These receive mention elsewhere. Hutchinson [1] circumcised a boy for *lupus* of the prepuce and obtained a perfect result. Rake, of Trinidad,[2] has performed circumcision on 16 *lepers,* and, even though the incision actually traversed a leprous patch, it always healed kindly.

Scabies.—Sometimes scabies produces papular, crusted and confluent lesions on the glans or skin of the penis, closely resembling the venereal sores. The lesion is crusted rather than ulcerative, typical burrows may be found, and the effect of sulphur ointment is magical.

Herpes Progenitalis.—This affection consists in the development of clusters of vesicles upon reddened patches on the mucous covering of the glans, or on either layer of the prepuce, or on other portions of the neighboring skin, attended by a slight sensation of heat and tingling. When occurring on the cuticular layer, herpes runs its course as it does elsewhere on the body, but when vesicles develop within the preputial orifice the epithelium of the vesicles is soaked off, little ulcerations result, more or less general inflammation is likely to arise from retention of the secretions, and balanitis, with posthitis, vegetations, and inflammatory phimosis, may be the ultimate result. Exceptionally the ulcerations become deep and angry, and the diagnosis from chancroid difficult, while the glands in the groin may inflame and suppurate.

The affection shows a marked tendency to recur. A tight prepuce and contact of irritating discharges act as predisposing causes.

Diagnosis.—Vesicles, usually in groups, always precede the ulcerations, while the latter are irregular in shape, superficial, and very rarely complicated by suppurating bubo. The pus is not auto-inoculable.

Treatment.—Until the vesicles break there is no treatment. Thereafter the ulcers should be dusted with any mild antiseptic powder. Recurrence may sometimes be prevented by circumcision; but often it cannot be prevented.

Herpes Zoster.—Zoster may occur upon the penis as elsewhere.

Lichen Planus.—This occurs on the glans penis, simulating almost precisely a squamous syphilid. They may be distinguished by the Wassermann reaction and by biopsy. Elliott states that the syphilitic eruption is never wholly confined to the glans.

[1] *Arch. of Surg.,* 1890, ii, 17.

[2] *St. Louis Med. and Surg. Jour.,* 1893, lxiv, 221.

Balanoposthitis.—Balanitis (*βάλανος, a gland*) is an inflammation of the surface of the glans penis. Posthitis (*πόσθη, the prepuce*) is an inflammation affecting the mucous surface of the prepuce chiefly. Neither can exist for any length of time without becoming more or less complicated by the other. For practical purposes they must be considered together.

Etiology.—Persons of irritable skin and gouty habit are predisposed to this disorder. A long and tight prepuce is always a predisposing cause. The exciting causes are mechanical irritation or uncleanliness from retention of smegma, or from contact with diabetic urine, gonorrheal, leukorrheal, menstrual, or other irritating fluids.

Symptoms.—The membrane at first becomes reddened, then mottled and moist; next the epithelium comes off in patches, leaving irregular excoriations which soon ulcerate and discharge a purulent fluid. The ulcerations are not preceded by vesicles. There is a burning soreness with itching at the end of the penis, usually scalding on urination. The entire prepuce may inflame, become red and infiltrated, producing inflammatory phimosis. The ulcerations rarely become deep, and the inguinal glands do not often suppurate, but they may grow somewhat large and tender. In chronic balanitis with phimosis, the mucous surface of the prepuce is granular and even condylomatous.

R. W. Taylor [1] has described a peculiar ringed affection of the prepuce and glans—narrow rings of reddened mucous membrane covered by a thin layer of epithelial scales. The inclosed area is normal, the rings vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. The affection is sometimes painful or itching. The rings remain stationary for a time. They may come out in successive crops. They get well without scar, slowly, under the use of arsenic internally. They should not be confounded with *lichen planus* of the glans penis.

Diabetic balanoposthitis is caused by contact of the saccharine urine.

Erosive and gangrenous balanitis [2] is a specific infection caused by a spirocheta and a bacillus quite similar to those found in Vincent's angina. The infection, if mild, results in superficial erosions about the corona or the adjacent portions of the prepuce, rarely on the glans penis. This infection may lead to ulceration, cellulitis of the prepuce, and even to gangrenous ulceration with perforation of the prepuce.

Erosive meatitis of little boys is a circumscribed lesion about the meatus described by Goldenberg.[3] It lasts a few months and heals spontaneously. The scab may close the meatus. Any mild ointment will prevent this.

[1] *Arch. of Med.*, 1884, vol. xii, No. 3.

[2] Cf. Corbus and Harris, *Jour. A. M. A.*, 1909, lii, 1474.

[3] *Am. Jour. Surg.*, 1910, xxiv, 218.

Adhesions due to balanitis are uncommon after early childhood. In elderly persons the possibility of *epitheliomatous degeneration* in a patch of chronic balanitis must be borne in mind.

Diagnosis.—Balanitis occurs only under a long or a tight prepuce. Simple balanitis must be distinguished by urinalysis from diabetic balanitis.

Ulcerative balanitis cannot be distinguished from inflamed herpes in many cases. It also closely resembles chancroid, from which it can often only be distinguished by examination of the organisms found in the satellite glands. Fortunately the treatment of severe cases of the three conditions is the same.

Treatment.—If the prepuce can be easily retracted without causing paraphimosis, simple balanitis may be speedily relieved. Cleanliness is of the first importance, but soap should not be used. Warm water and peroxid, āā, will remove all the discharges. After washing, the parts should be dried by gently touching them with a soft cloth, and dusted (by the aid of a dry camel's-hair brush from which the powder may be evenly shaken) with bismuth and calomel, or any fine powder. A piece of old linen, just large enough to cover the glans, and with a hole cut in its center so that it may be slipped like a collar around the corona, is now to be moistened in a mild antiseptic solution (acetate of aluminum 2 per cent, or aromatic wine and water, equal parts) and laid over the glans, leaving the meatus uncovered. The prepuce is then pulled forward to its natural position. In this way friction between the inflamed surfaces is avoided, all the discharges are absorbed, and a mildly stimulating fluid is kept in constant contact with the ulcerated or abraded surfaces. The dressing should be repeated two to four times daily, according to the discharge. After recovery a dry piece of linen should be kept between the glans and the prepuce for some weeks, renewed twice daily. Argyrol, sol. saturat., is an almost infallible application. It should be employed in all severe cases.

If the prepuce cannot be retracted, it should be incised, as for chancroid, and sores and wounds bathed lavishly in 20 per cent argyrol solution.

If chancroid be present, inoculation of the wound is inevitable. Yet chancroidal cases require operation most urgently in order to expose the sore, whose ravages (perhaps upon the glans penis) are progressing uncontrolled. A large chancroid exposed is better than a small one concealed.

Circumcision.—In chronic and inveterate cases, or where insignificant causes produce constant relapse, circumcision affords a certain cure. Circumcision of diabetics, while almost certain to prove curative, may result in gangrene.

ACUTE INFLAMMATORY AFFECTIONS OF THE PENIS

Cellulitis.—Cellulitis arises from chancroids, balanoposthitis, trauma, or gonorrheal peri-urethritis. The inflammation may spread to the abdomen, scrotum, or thighs, or it may involve the erectile bodies.

Lymphangitis.—Lymphangitis is comparatively benign. A lymphangitis of the large dorsal lymphatic may be differentiated from phlebitis of the dorsal vein by the fact that the cord of induration extends outward, at the root of the penis, toward a group of enlarged glands, instead of disappearing beneath the symphysis pubis.

Erysipelas.—Erysipelas of the penis is rare. It usually spreads to the penis from the adjoining regions. It is likely to be virulent and complicated by cellulitis (phlegmonous erysipelas).

Treatment.—Prophylaxis, by careful treatment of the causes of inflammation, is of the first importance. If the penis has already become inflamed it should be elevated, with the scrotum, and wet dressings of sublimate (1: 10,000) or aluminum acetate (2 per cent) applied daily. Rest in bed, free purgation, and a light diet are essential in the more severe cases. Tension may be relieved by incision, abscesses must be opened and drained, and sloughs speedily removed.

Cavernitis and Penitis.—Inflammation of the corpora cavernosa or of all three erectile bodies arises from cellulitis or its causes, especially inflammation in the bulb of the corpus spongiosum.

Course.—The course of the disease is that of an acute inflammation with constant priapism and edema added to the usual local symptoms. While the inflammation may be walled in by occlusion of the vascular spaces, pyemia is "a terribly frequent complication" (Jacobson).

Treatment.—The treatment should therefore be most energetic. Indurations in the erectile bodies should be freely incised, packed to check the hemorrhage, and later irrigated frequently.

OTHER DISEASES OF THE PENIS AS A WHOLE

Chronic Edema.—Chronic edema may be caused by elephantiasis or by general anasarca. The swelling of the scrotum usually overshadows that of the penis and may be so great as practically to obliterate that organ. In the penis the edema is greatest in the prepuce and especially about the frenum. This edema may offer a mechanical impediment to urination, and the low vitality of the tissues renders them especially liable to become inflamed by contact with the urine that dribbles over them.

Treatment.—The prepuce must be kept dry and dusted with a

soothing powder. Multiple punctures or incisions may liberate the exudate sufficiently to keep the swelling within bounds, and, these failing, a dorsal incision will succeed. Light edema may be controlled by bandaging and elevation.

Dilatation of the Lymphatics.—This condition is secondary to trauma or inguinal adenitis. The dilated lymphatics appear as white, subcutaneous cords encircling the penis behind the corona or extending along the sides or dorsum. There are no subjective symptoms and the obstruction may be relieved spontaneously. For esthetic reasons multiple ligation or total excision may be resorted to, but a lymph fistula may result from such treatment.

Elephantiasis.—(See p. 553.)

Gangrene is usually the result of inflammation. It may, however, come on independent of any local inflammation. Spontaneous gangrene usually occurs in connection with the acute exanthems. Cases have been reported from typhoid, typhus, intermittent fever, and small-pox. Senile and diabetic gangrene also occur. Cases following prolonged priapism, iliac thrombosis, atheroma of the dorsal artery, exposure to cold, and acute alcoholism are also cited by Jacobson.

Treatment.—The prophylactic measure—incision of inflammatory and edematous areas—has already been noted. When gangrene has once declared itself, attention to the patient's general condition, the preservation of dryness, asepsis, and warmth locally, and the prompt removal of all frankly gangrenous tissue are the therapeutic indications. Later, plastic work may be required to cover areas left bare of integument. Cicatricial deformity of the erectile bodies can be remedied only by time.

Tuberculosis.—Tuberculous urethritis apart, tuberculous ulcers may appear upon the glans or result from infection during ritual circumcision. The diagnosis depends upon the pathological examination of a snipping from the ulcer.

Treatment.—The Finsen light, the x-ray, the actual cautery, and simple curettage have all achieved cures. I have seen one case cured by the cautery, one improved by the x-ray.

CHAPTER LXVII

PHIMOSIS—PARAPHIMOSIS—TUMORS OF THE PENIS

Preputial Deformities.—Practically, the deformities of the foreskin (phimosis and atresia of the orifice excepted) are unimportant. The prepuce is sometimes bifid, enlarged into a pouch, redundant, or rudimentary. When the prepuce is deficient, the epithelium of the uncovered glans penis becomes hard and tough, more nearly resembling ordinary cuticle. Under these circumstances its sensibility is diminished, but it is less liable to become excoriated or inflamed. Hence, absence of the prepuce is not to be regretted, and the operation for its restoration (posthioplasty) need not be described.

PHIMOSIS

Phimosis exists where the orifice of the prepuce is so small that the glans penis cannot be uncovered. The orifice of the prepuce may be congenitally absent (atresia preputii). Phimosis is congenital or acquired, simple or inflammatory, or complicated by other diseases or by adhesions.

In young children preputial redundancy is so common that it may be considered normal. The foreskin of an infant is developed out of all proportion to the rest of the penis, taking the member after puberty as a standard of comparison. Whenever the prepuce can be fully retracted there need be no anxiety about the future; the preputial orifice will enlarge sufficiently before or at puberty.

Phimosis may be brought about secondarily through induration and inelasticity of the skin caused by frequent attacks of preputial inflammation. The meshes of the connective tissue, at first distended with serum, become secondarily thickened and hypertrophied, leaving a thick, indurated, inelastic prepuce that cannot be retracted. This condition is known as inflammatory phimosis.

Another common cause of acquired phimosis is the cicatrization of multiple chancroids around the orifice of the prepuce. Infrequently, diabetic eczema produces phimosis. Demarquay quotes a case where a passionate and jealous woman made her lover wear a gold padlock with which she secured the preputial orifice, keeping the key herself.

The victim of her charms carried his padlock, which was replaced from time to time through new punctures, during four or five years, until such a degree of irritation had been set up that Petroz and Dupuytren, when consulted, diagnosticated cancer, and removed the prepuce. No relapse of the cancer is recorded.

Treatment.—Circumcision in infancy will leave the patient less subject to venereal disease and to sexual irritability in later years. For this reason the operation has of late years attained great popularity. I favor it for all infants whose foreskins are long or tight.

A positive indication for operation upon a child does exist, however, when the preputial orifice is smaller than that of the urethra. This condition is evinced by ballooning of the prepuce during micturition, for the urine flows into the cavity more rapidly than it can escape from the orifice. The retention of a drop or two of urine in the cavity of the prepuce after each act of urination leads to balanitis, suppuration, the growth of vegetations, formation of the preputial stone, or incrustation of the glans.

When the adult prepuce is tight, an operation may be called for, even though phimosis, strictly speaking, does not exist. For example, the collection of smegma, or repeated attacks of herpes, may necessitate operation. Again, if an individual with a tight prepuce gets chancre, chancroid, or gonorrhea, serious inflammatory complications are likely to arise.

PARAPHIMOSIS

Paraphimosis exists when the prepuce is retracted behind the corona glandis and cannot be replaced.

Causes.—An unnaturally tight preputial orifice is a predisposing cause to paraphimosis.

Inflammatory paraphimosis may depend upon balanitis, gonorrhea, herpes, chancroid, chancre, etc.

Symptoms.—The glans penis is swollen and livid. Behind the corona, most marked below, rises a tense, shining, edematous belt of the mucous layer of the prepuce. Behind this there is a deep sulcus or furrow, most marked above, often the seat of superficial ulceration. Here lies the stricture; behind it there rises another edematous fold, usually smaller than the one in front (Fig. 134).

If the stricture of the prepuce is tight enough to arrest the circulation, it may finally cause the destruction by gangrene of all tissues lying in front of it.

Treatment.—Reduction may almost invariably be accomplished without incision, if the following details are observed, viz.:

1. The stricture must first be pulled well back. Exceptionally the

Fig. 134.—Paraphimosis.

Fig. 135.—Paraphimosis. The edema is squeezed out preparatory to reduction.

mucous membrane is unfolded at the dorsum; this must be smoothed out by still further retracting the prepuce.

2. The edema must be thoroughly squeezed from in front of the stricture to the shaft of the penis behind it. Until one has patiently squeezed such a penis for several minutes, it is quite incredible how fully the edema may thus be reduced and shifted to the shaft of the penis (Fig. 135).

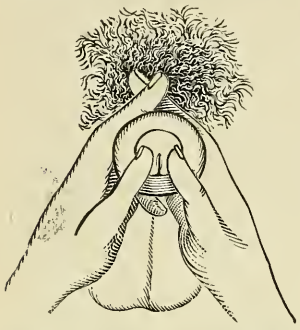


Fig. 136.—Reduction of Paraphimosis.

3. Reduction is then accomplished by forcing the stricture slowly over the head of the penis—so slowly as to squeeze out the remaining edema. It is futile to attempt to pry the stricture over the glans until the edema has been reduced.

The following is the best method of reduction: Seize the penis behind the strictured prepuce in the fork of the index and middle fingers of both hands, one placed on each side. Now make pressure with the thumbs on both sides, in such a direction as to compress the glans laterally, rather than from before backward, and at the same time pull the strictured portion of the prepuce forward, the effort being rather to pull the stricture over the glans than to push the glans through the stricture (Fig. 136).

If a prolonged, careful attempt at reduction fails, the strictured point must be divided. This may be done under local anesthesia.

After reduction, the treatment consists in elevation of the penis within a jock strap, and syringing the preputial cavity with a mild antiseptic solution.

TUMORS OF THE PENIS

Gumma.—Gumma occurs often in the glans or the prepuce, very rarely in the urethra and the corpora cavernosa. The so-called relapsing chancre is a gummatous deposit in the scar of the initial lesion. The history, the influence of treatment, and, if necessary, the examination of a section of the growth determine the diagnosis. In the corpora cavernosa gumma resembles circumscribed fibrosis, but is deeper, less cartilaginous, and almost always occurs in the posterior third of the organ (Zeissl).

BENIGN TUMORS OF THE SKIN AND CONNECTIVE TISSUE

Cysts.—Implantation, and sebaceous cysts occur. The last originate in the sebaceous glands of the skin or in Tyson's glands. Cysts occur

almost always in the prepuce and are readily enucleated. (Cf. Gerulanos.[1])

Benign Neoplasms.—Lipoma, adenoma,[2] and angioma have been described. They are rare, and their removal is a question of judgment involving a recognition of the function of the penis as an intromittent organ, and the possible loss of this function from the formation of a cicatrix.

Papilloma.—More important because of their frequency are the papillomata (*condylomata acuminata*) of the penis. They are commonly denominated *venereal warts.* This title, however, is not exact, since there is no necessary connection between them and any venereal disease. They are papillary overgrowths, often highly vascular, and composed of epithelium. They may be prominent and pedunculated, or flat, and growing from a considerable surface. They are nearly always multiple. They are caused by inflammation, or simply by lack of cleanliness. Consequently the most favorable condition for their production exists in gonorrhea, in balanitis, or when mucous patches occupy the cavity of the prepuce. Their favorite seat is just behind the corona glandis, but they are also encountered anywhere within the cavity of the prepuce, at its orifice, upon its cutaneous surface, or even within the urethra. They are found also upon the scrotum, and frequently around the anus. They are, when numerous, bathed in a fetid, puriform secretion, and may grow large enough within the prepuce to cause phimosis. They occur upon young children, and are found in their greatest luxuriance within and around the vulvae of women affected with irritating discharges—discharges not necessarily venereal in any sense.

Implantation warts also occur after circumcision.

Diagnosis.—Warts should be differentiated from mucous patches and condylomata lata by the typical flat appearance of the syphilitic lesions and the accompanying symptoms of the disease.

From commencing epithelioma the diagnosis may be extremely difficult. When in doubt examine a snipping under the microscope, and if it appears benign, treat it as such, but remove it in any case. If it recur, and the patient is over fifty, it is safest to exsect it as though it were epitheliomatous, whatever the findings of the pathologist. Radium is very efficient for this class of cases.

Prognosis.—Unless kept scrupulously clean, warts sometimes ulcerate, and they may even suppurate, light up suppurating buboes, and even cause gangrene of the penis. Simple cleanliness, on the other hand, often causes them to atrophy.

Epitheliomatous degeneration may take place, and is always to be

[1] *Deutsche Zeitschr. f. Chir.,* 1900, lv, 326.

[2] "Morrow's System," 1893, i, 58.

feared. Implantation warts are especially liable to hypertrophy and become *horns*.

Treatment.—Repeated washing with soap and water followed by the application of calomel often causes vegetations to shrink up and disappear. In any case this is essential. In case vegetations are complicated by balanitis, treatment of the latter will often at the same time triumph over the warts. But circumcision is usually required.

The most valuable local application is a 10 per cent mixture of salicylic acid in acetic acid.[1] This forms a chalk and water mixture of which the moist chalk is smeared over the warts. One or two applications cause the growths to wither away and drop off. If they persist, however, all the pedunculated growths may be removed with curved scissors, and the surface from which they grow cauterized with nitric acid or any other escharotic. The x-ray, the high frequency current, and radium are efficacious for obstinate cases. Lactic acid—pure for small lesions, in one per cent solution for extensive ones—is highly spoken of by Watson.[2]

Horns.—Horny growths may spring from the glans or the integument. They begin as warts and are very prone to epitheliomatous change. Brinton [3] has described a curious case and collected others from the literature. Baldwin [4] and Bruce Clark [5] mention others.

BENIGN TUMORS OF THE ERECTILE BODIES

The benign tumors of the erectile bodies of the penis are four: *circumscribed fibrosis, enchondroma, osteoma, and calcification.* The first is comparatively rare, the others extremely so.

Circumscribed Fibrosis.—I have come to prefer this name for the malady heretofore usually known as *chronic circumscribed inflammation of the corpora cavernosa,* for the condition is a fibrosis, not an inflammation.

The malady is gouty in origin, comparable to Dupuytren's contraction of the palmar fascia. It usually appears between the ages of thirty-five and fifty.

Pathology.—The growth occurs in the sheath of the erectile body. It is a fibrosis which may show patches of enchondroma (Stopczanski [6]).

Symptoms.—The affection comes on insidiously, without apparent cause, although the patient sometimes ascribes it to injury. The first symptom is a bending or a slight pain at a certain point in the penis

[1] Not glacial.
[2] *Lancet,* Apr., 13, 1913, No. 4624.
[3] *Med. News,* 1887, li, 141.
[4] *Ibid.,* 449.
[5] *Lancet,* 1894, i, 219.
[6] *Wien. klin. Wochenschr.,* 1908, xxi, 318.

when the organ is erect. Examination detects a hard, flattened mass with sharply defined margins, occupying one or both corpora cavernosa near the surface, and feeling like cartilage—elastic, springy, not as bony as a calcareous plate. The corpus spongiosum does not participate in the disease. The penis bends during erection at the affected point, and along the edge of the hardness a little pain is experienced. This indurated mass, which is usually irregularly oval in shape, may remain stationary for an indefinite period; or it may progress slowly backward or forward, sometimes retaining its size and shape, sometimes growing larger, sometimes smaller.

A slight tenderness is perhaps felt along the line of advancing induration, and moderate uneasiness is usually produced by pressing the induration between the fingers or by erection. The seat of election is the septum and adjacent portions of the sheath on the dorsum of the penis, not far from the glans.

Prognosis.—The prognosis is negatively good in that the fibrous mass never ulcerates or becomes cancerous, may get spontaneously better, even possibly well, or may, and sometimes does, develop backward until it gets so low down toward the root of the penis that it no longer seriously interferes with upright erection. I have seen more than one patient who, at one time being debarred from sexual intercourse, has by a shifting of the position of the induration again become potent. I have met one person with a distinct plaque of some size, of which he had no knowledge whatever. The distinction between fibroma and enchondroma can only be made pathologically; clinically it is unimportant. The tendency to ossification manifests itself so rarely that it is a negligible quantity.

Treatment.—An effective treatment of this singular malady is yet to be discovered. Thus far time only has seemed to help it.

Thiosinamin, antisclerosin injections, blisters, oleate of mercury, tincture of iodin, the iodids, and electrolysis, have uniformly failed. Excision only replaces the fibrosis by scar tissue. Piperazin is well spoken of.

Calcification and Ossification.—Both of these conditions are usually, probably always, secondary to fibrosis, or enchondrosis of the erectile bodies. Calcification of small patches is quite rare, ossification is even more unusual. Cases of this latter condition have been reported by von Lenhossek,[1] Demarquay,[2] Porter,[3] Jacobson,[4] and Chetwood.[5] In Chetwood's specimen certain spots were simply fibrous, others were cartilagi-

[1] *Virchow's Archiv,* 1874, lx, i.
[2] *Op. cit.,* p. 354.
[3] *N. Y. Med. Record,* 1882, 270.
[4] *Op. cit.,* p. 683.
[5] *Jour. of Cut. and Gen.-Urin. Dis.,* 1899, xvii, 231.

nous, while the bulk of the growth was true bone. To compare penile osteoma with the bony development normal in the penes of certain monkeys is scarcely logical.

Prognosis.—Calcification or ossification may cease after more or less of each corpus cavernosum has suffered, or it may involve the whole organ pretty generally. Sexual intercourse may be seriously interfered with, if not prevented altogether.

Treatment.—Medicine holds out no hope to the sufferer. If the disease has come to a standstill and the deposit is superficial and small, it may be removed with the knife—an operation which has been performed with success by Regnoli, MacClellan, and Huitfeldt.[1]

MALIGNANT NEOPLASMS OF THE PENIS

The primary malignant new growths of the penis are *sarcoma* and *epithelioma*. The former is very rare. It arises from the erectile bodies, usually the corpora cavernosa. The latter, much more common, begins on the glans or on the prepuce. (Epithelioma of the urethra is considered with the other diseases of that canal.)

Secondary new growths present no peculiar features. They either form part of a disseminated carcinosis or are mere extensions of the tumor from an adjoining region, usually the scrotum.

Sarcoma.—With or without previous trauma a tumor appears in one of the erectile bodies. The fact that it is a distinct lump and not a flat indurated patch readily distinguishes it from the benign tumors of these structures. Moreover, sarcoma usually appears in early manhood and develops with characteristic rapidity and early involvement of the inguinal glands. Exceptionally, however, it grows slowly and the glandular involvement occurs late. Of the 13 cases recorded by Jacobson [2] some arose from the erectile tissue, some from the fibrous sheath, and one—a melanotic sarcoma—apparently originated in the urethral mucous membrane. The earlier cases were reported as fibroma or carcinoma. As the tumor grows it causes priapism by occluding the cavernous spaces, and may also occlude the urethra and so cause retention of urine. Early amputation of the penis is the only *treatment*. The *prognosis* is absolutely bad.

Epithelioma.—Epithelioma of the penis (Fig. 135) begins on the prepuce or glans, both of which are usually involved when the patient presents himself for examination.

Though Freyer [3] has reported a case in a youth of seventeen, and Kaufmann places 6 per cent of the cases in the third decade, here, as

[1] *Norsk Mag. f. Lacgevid.*, 1910, lxxi, No. 1.
[2] *Op. cit.*, p. 738.
[3] *Brit. Med. Jour.*, 1891, i, 1173.

elsewhere, epithelioma is usually a disease of later life. One case developed in the scar of a horse-bite, others have arisen from the scars left by venereal sores, a few from urethral fistula; but warts and chronic balanitis are the most fruitful sources of epithelioma, the former especially if neglected and allowed to remain foul and moist. Indeed, 29 out of 33 cases collected by Kaufmann began as apparently benign warts. Finally, *phimosis is a marked predisposing cause of epithelioma.* By retention of the smegma and urine it predisposes the patient to

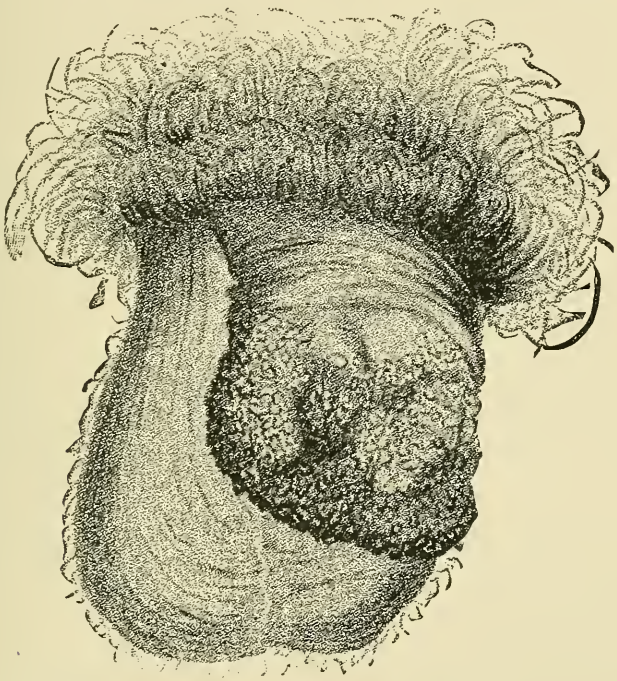


FIG. 137.—EPITHELIOMA OF THE PENIS (Wyeth).

balanitis, vegetations, and fissures of the foreskin, and these processes once set up are kept concealed and constantly bathed in an acrid and irritating fluid. Demarquay noted phimosis in 42 out of 59 cases, and it is claimed that the circumcised Jew is exempt from penile epithelioma. The question of inoculation from cervix uteri is agitated from time to time, but the extreme rarity of the cases adduced indicates that they represent nothing more than a curious coincidence.

SYMPTOMS AND COURSE.—Although epithelioma of the penis is not often seen until well under way and absolutely characteristic, the various aspects under which it first presents itself must be appreciated in order that intelligent radical treatment may be resorted to early.

In about 5 out of 6 cases the disease begins as a wart situated on the

glans or on the inner surface of the prepuce. This wart is intractable to ordinary methods of treatment, and recurs if cut or burned away. As it grows it assumes a lobulated, cauliflower appearance, and soon begins to ulcerate in places, and to exude the characteristic foul ichorous discharge. Then the base gradually takes on the hard induration of the epitheliomatous ulcer with everted edges. By this time the inguinal glands are probably involved and may be felt as shotty subcutaneous nodules in either groin. (For the lymphatics of the penis so anastomose that a so-called crossed bubo—the sore on the one side of the penis and the bubo in the opposite groin—occurs not infrequently.)

More rarely epithelioma begins as a raw spot or an indolent ulcer, and still more rarely it appears first as a subcutaneous nodule or as a patch of leukoplakia.

In whatever way the disease begins, it comes after a time to the frankly cancerous stage. The ulcer advances, involving all the tissues in its path; the discharge is thin, sanious, fetid; the ulcer deep, irregular, unhealthy, its edges hard, livid, and everted. At the same time the exuberant warty growth progresses, either of these conditions predominating to make the case clinically a warty or an ulcerative lesion.

The inguinal glands now become prominent and partake of the pyogenic as well as of the cancerous infection, so that they become matted together, and may even suppurate or produce an epitheliomatous ulcer in the groin.

Locally, the growth may spread over quite a large superficial area without involving the corpora cavernosa, but when these become invaded secondary growths develop to their very depths. Involvement of the corpus spongiosum results in stricture.

Lancinating pain is a prominent symptom only late in the disease. The chief inconveniences to the patient in the earlier stages are the presence of the growth, the foul discharge, the tendency to annoying hemorrhage after the slightest abrasion, and urethral stricture. As the disease advances the strength of the patient fails. The tumor spreads up over the penis to the pubes, abdomen, and thighs, joining the ulcerated inguinal glands and extending down over the scrotum to the perineum, anus, and buttocks, until, finally, the patient dies of sepsis, cachexia, or hemorrhage.

Diagnosis.—The diseases which may be confused with epithelioma of the penis are warts, chancre, chancroid, tuberculous ulcers, and ulcers from chronic balanoposthitis.

As we have seen, the appearance of epithelioma is characteristic enough after its base has become indurated and the infection has begun to spread to the inguinal glands; but it is of the greatest importance that the diagnosis be made before that time, while the disease is yet emi-

nently curable. To this end all growths or ulcers that prove intractable should be regarded with suspicion, and if that suspicion is confirmed by microscopical examination of a snipping from the diseased tissue, immediate operation should be insisted upon.

Prognosis.—Before the inguinal glands become involved the operative prognosis is good. Afterwards it is bad, yet not absolutely so, for cures are reported in cases where unmistakable gland involvement had occurred.

Treatment.—If the growth be seen before induration has occurred it may usually be removed by circumcision if on the prepuce, or by thorough cauterization if upon the glans. Patches of leukoplakia upon the glans penis or the foreskin should be promptly destroyed by knife or cautery. The patient should, however, be warned of the danger of recurrence, and should this appear, or should there be some induration about the base of the tumor, the penis must be amputated behind the corona, and the inguinal glands of both sides extirpated, whether they are palpably enlarged or not, for the microscope has repeatedly shown these glands to be the seat of malignant deposits though their gross appearance was quite normal.

If the glans is extensively involved, the penis must be amputated close up to the pubes, or else extirpated entirely. Jacobson claims that simultaneous castration adds to the comfort of these patients, though most men refuse to part with their testicles even when their function has thus ceased.

Barney reported 100 cases.[1] Though 80 recurred within five years (and 12 thereafter), 11 out of 26 cases operated upon for recurrence remained well five years thereafter. Though excision of the inguinal glands is imperatively required for all but the earliest cases, it is noteworthy that 20 were cured by primary, and 8 by secondary, amputation without adenectomy, while only six were cured after the combined operation: in other words, almost all the advanced cases die in spite of operation.

[1] *Ann. Surg.*, Dec., 1907, p. 890.

CHAPTER LXVIII

CHANCROID

Chancroid (or soft chancre) and hard chancre are no more akin than measles and leprosy; and it is unfortunate that the ancient confusion of the local and the general infection has left us this legacy of misleading terms; but it is now too late to change them.

Chancroid is a specific, local, contagious, auto-infectious venereal ulcer.

It is specific in that it is caused by a specific microörganism, the streptobacillus of Ducrey.[1]

This bacillus is dumb-bell shaped, thick and rounded or square at the ends, constricted in the middle. It varies in length from 1.5 to 2 μ. It groups in parallel chains, and occurs both inside and outside the cells (Fig. 138). It stains readily with the ordinary dyes (methylene-blue, or violet, or fuchsin), and is decolorized by the Gram stain.

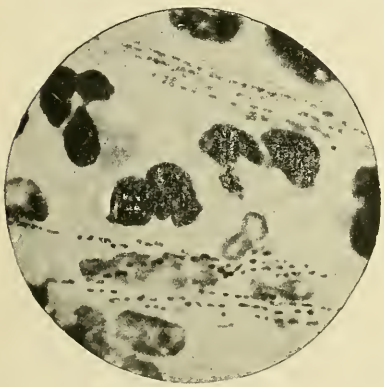


Fig. 138.—Streptobacillus of Ducrey. (Lincoln Davis.)

For many years after its discovery in 1889, in spite of the confirmatory observations of Unna, Kretling, Dubreuilh, and Lasnet, etc., and in face of the manifestly specific character of chancroid, the pathogenic action of the streptobacillus was doubted until proven by the culture and inoculation experiments of Istamanoff and Askpianz,[2] Lincoln Davis,[3] Lancret,[4] and Tomasczewski.[5] But chancroid is peculiarly liable to mixed infection. A smear taken from the surface of the ulcer usually shows numerous pyogenic and other bacteria, and few if any of the pathogenic bacilli. Hence such a smear cannot be depended upon for diagnosis.

[1] *Riforma medica,* 1889, vol. v, p. 98.
[2] *Jahresbericht d. Path.—Microörg.,* 1898, vol. xiv.
[3] *Jour. of Med. Research,* 1904, vol. ix, p. 401.
[4] *Bull. méd.,* 1898, vol. xii, p. 1051.
[5] *Zeitschr. f. Hygiene u. Infect.,* 1903, vol. xiii, p. 327.

Chancroid is a local lesion, causing no systemic infection or reaction. *It is,* therefore, indefinitely *auto-inoculable.* Indeed, the marked tendency to auto-inoculation is one of the most striking clinical characteristics of the ulcer. That *it confers no immunity* whatever was amply proven by the disciples of syphilization. Lindemann, for example, inoculated himself 2,700 times with chancroidal pus in the vain hope of immunizing himself against syphilis. But a local and temporary immunity does exist; for after many inoculations a given region becomes temporarily immune, though the virus will still take on other parts of the body.

Clinically, however, such immunity has no significance.

Finally, *chancroid is a contagious venereal ulcer.* Not once in a hundred cases does one see a chancroid except about the genitals. This is as much as to say that it is practically always acquired by sexual contact. Although many cases of mediate contagion have been reported (the virus being usually conveyed by the hand), such cases are proportionately extremely rare. Indeed, chancroid will not "take" upon the integument unless it is abraded. Cullerier's experiments show that this must oftentimes be true of the vagina as well. In two cases he deposited pus from a chancroidal bubo in a clean vagina, and let it remain there between half an hour and an hour. Then some of the vaginal secretion was collected and inoculated upon the thigh, after which the vagina was thoroughly cleansed. In both instances typical chancroids developed on the thigh while the vagina remained clean.

Hence, be it noted, a woman may convey chancroid from one man to another without herself becoming infected.

Yet auto-inoculation of chancroid upon the healthy skin or mucous membrane lying in contact with it is extremely common. But it takes many hours of intimate contact to effect the inoculation.

FREQUENCY

In the clinic, chancroids outnumber true chancres two to one. In private practice the preponderance is reversed, and we see five, or even ten, chancres to one chancroid. The reason for this is twofold. In the first place, chancroid can never make headway among cleanly persons, for it is so foul and disgusting that no decent citizen infected with it would attempt sexual intercourse until it is cured, and half a cure—such as so commonly conceals the infectiousness of syphilis and gonorrhea—is here impossible. In the second place, in most instances, a little soap and water at the time of exposure is an absolute safeguard against it.

Chancroid flourishes only where soap and water are not esteemed.

SITUATION AND NUMBER

Chancroids upon the male genitals are most common in the coronary sulcus, especially in the little pocket on each side of the frenum. Urethral chancroid is extremely rare.

In women the sores usually occur about the introitus, rarely higher up.

From these regions the ulcers may spread by contact or by direct extension over external genitals, anus, thighs, abdomen, and even farther afield.

Chancroid commonly begins as a single ulcer; but no sooner has this appeared than secondary ulcerations begin, so that by the time the physician is consulted several sores are usually present.

SYMPTOMS AND COURSE

Incubation.—The disease has an incubation period varying from one to ten days, usually three to five. A protracted incubation is probably due to the fact that the virus is retained some days within the prepuce (or vagina) before inoculation occurs.

FIG. 139.—CHANCROIDS OF PREPUCE, PREPUTIAL FRENUM, AND GLANS PENIS, IN VARIOUS STAGES OF DEVELOPMENT. (Kaposi.)

Onset.—The symptoms of chancroid are best observed by studying the course of the artificial ulcer produced by inoculation. Within twenty-four hours after such an inoculation a reddish blush surrounds the puncture. This soon changes to an inflamed areola which, in the third day (rarely sooner or later), becomes a pustule. This extends quite rapidly, and within a few days breaks and becomes a characteristic chancroidal ulcer (Fig. 139).

The Ulcer.—The typical chancroid is a round ulcer with undermined or perpendicular edge. The

ulcer is usually rather deep. Its base is irregular, grayish yellow, and covered by a pultaceous false membrane. It is surrounded by a non-indurated, inflammatory areola. The secretion is abundant and purulent. It bleeds readily. It may be intensely painful.

Course.—If untreated and uncomplicated the ulcer increases in size for a week or two. Then, having attained a diameter of about 1 cm., it remains stationary for about two weeks, and then gradually heals by cicatrization from the edges toward the center. So rarely, however, is the ulcer both uncomplicated and untreated that the stage of spontaneous healing is not seen in the clinic.

COMPLICATIONS

The common complications of chancroid are mixed infection with syphilis (mixed sore), mixed infection with pyogenic microbes (inflamed chancroid), destruction of the frenum, phimosis, gangrene and phagedena, balanoposthitis and venereal warts, lymphangitis, adenitis (bubo).

The Mixed Sore.—*So long as your patient has chancroid you may never be sure that he has not chancre.* This rule is without exception. A chancroid may readily conceal a chancre from the most experienced eye. A chancroid may refuse to heal because of complicating *gumma.*

A very large proportion of sores treated in the clinic as chancroids are actually chancres, for many cases of unsuspected syphilis date back to a "chancroid."

The Inflamed Chancroid.—While every chancroid is more or less irritated by its own secretions and contaminated by ordinary pyogenic microbes, the resulting inflammation is often insignificant unless accentuated by friction.

The chancroid at the preputial orifice is usually an interminable while getting well. The friction of shirt and drawers, or even the rubbing of the softest dressing, so irritates the sore that, though it may lose all its chancroidal characteristics and become a simple, sluggish abrasion, it lingers on week after week, taxing to the utmost the victim's patience and the physician's skill.

Chancroid underneath a long prepuce, however loose, usually excites so acute a cellulitis in the connective tissue of the foreskin as to cause *inflammatory phimosis.* This retains the secretions of the chancroid, which, bathed in this irritating pus and protected from effective treatment, promptly invades both glans and prepuce, and instead of healing tends rather to eat its way through the glans penis into the urethra or through the foreskin, at the same time setting up an intense inflammation, which may terminate in abscess, erysipelas, or gangrene.

If the prepuce is retracted in a desperate effort to get at the suppurating cavity, paraphimosis complicates matters.

Destruction of the Frenum.—One of the commonest complications of chancroid is destruction of the preputial frenum.

The frenum is destroyed in the following manner: a chancroid appears in the sulcus at one or both sides of the frenum; as it enlarges it eats a hole in the frenum, leaving a narrow string, which soon gives way as well.

Gangrene and Phagedena.—The terrible phagedena which, until the era of antisepsis, was an imminent possibility for every case of chancroids, has almost passed into oblivion with hospital gangrene and such ancient horrors. One can no longer imagine such a case as Ricord treated for several years, and which, commencing as a chancroidal bubo fourteen years before, was still an open ulcer at the knee—indeed, this may well have been a gumma.

On the other hand, *gangrène foudroyante* is still occasionally encountered as the complication of stricture, or of chancroid. Thus Martin [1] relates and depicts the case of a man who lost two-thirds of his penis by gangrene in thirty-six hours. Happily, such cases are extremely rare.

Most "phagedenic chancroids" are gummata with a negative Wassermann reaction.

Lymphangitis.—Acute inflammation of the lymphatics running along the dorsum and sides of the penis toward the inguinal glands is a rare complication. Suppuration therein is much rarer.

Inguinal Adenitis.—Chancroid of the genitals causes inguinal adenitis or bubo. This complication occurs about once in every three cases. The bubo when bilateral is usually more severe on the side upon which the sore lies; but, on account of an abnormal lymphatic supply, the glands in the opposite groin may be the more inflamed. This is the so-called "crossed bubo."

The chancroidal bubo may be a simple inflammatory adenitis, the glands becoming large and quite tender, so remaining for a week or more, and then slowly resolving.

It may go on to peri-adenitis. The glands become matted together in irregular, tender masses adherent to the skin and to the subjacent tissues. When the inflammation reaches this stage it terminates by suppuration. When the abscess is incised or breaks, it usually forms a chancroidal ulcer. This is the so-called virulent bubo.

It has long been known that chancroidal pus, although it would remain virulent for many weeks if kept in a sealed tube, promptly lost its virulence when heated to a temperature of 105° F. It is, therefore, to be inferred that both "simple" and "virulent" buboes are due to

[1] Morrow's "System," p. 875.

infection by the streptobacillus, but that the heat engendered in the inflamed gland is sufficient to reduce its virulence sometimes to the point of rendering it temporarily innocuous; so that it only requires a few days of cooling off, as it were, in the open ulceration to regain its primitive vigor.[1]

DIAGNOSIS

The diagnosis of chancroid may be made by the microscope (which gives no negative assurance), by culture on blood agar, by the ancient and very trustworthy method of auto-inoculation,[2] or by confrontation (examination of the person from whom the sore was contracted).

Generally speaking, however, no test is required to establish the diagnosis of chancroid. The multiple, virulent sloughing ulcers, spreading by contact inoculation, the characteristic bubo, and the history of very recent exposure form a typical clinical picture. Inflamed herpes or simple ulcer may, however, very closely simulate beginning chancroid. Moreover, the chancroid may originate in the orifice of a sebaceous gland of the scrotum or penis (follicular chancroid), and so be mistaken at first for a small boil or an acne pustule. Bullous and ecthymatous forms of chancroid are extremely rare.

But the really important point in the diagnosis of chancroid is its differentiation from true syphilitic chancre. The details of this differentiation are considered elsewhere (p. 821); but it is not amiss to repeat once again that *no matter how sure you may be that a given sore is a chancroid, you cannot thereby make a negative diagnosis of syphilis;* for the same coitus that transmitted the chancroid may have transmitted syphilis, the chancre of which might not develop until after the chan-

[1] Thus Dubreuilh (*Jour. de méd. de Bordeaux,* 1893, vol. xxiii, p. 573) has reported an epidemic of chancroids producing 136 buboes. Of these, 27 did not suppurate; 43 were incised, the pus was sterile to culture and they healed rapidly; 51 became virulent, though sterile when incised; only 3 were virulent at the time of incision; and 12, which were open on admission to the hospital, were all virulent.

[2] To perform *auto-inoculation,* cleanse a spot on the outer side of the patient's thigh with alcohol; then with a clean bistoury or pin wipe a little pus from the suspected sore; twirl the point of the instrument into the skin at the point to be inoculated just deep enough to draw the most minute drop of blood, smear the spot well with the virus, and clap on a vaccination shield. A "take" is announced by the appearance of a typical chancroid on the third day. This should promptly be destroyed by cauterization.

The mere appearance of a pustule or an ulcer after inoculation proves nothing. It must be chancroidal in type to be considered trustworthy evidence. If, after inoculation, there is still some doubt of the nature of the "take," *its secretions may be examined for the Ducrey bacillus with better prospect of success than in the original sore,* or the diagnosis may be confirmed by hetero-inoculation (inoculation of another person).

croid was cured, or might develop on the chancroid, and be so insignificant as to escape the most careful scrutiny.

TREATMENT

Abortive Treatment.—A chancroidal ulcer not more than three or four days old may be completely destroyed by the application of pure nitric acid after anesthetization with 10 per cent cocain solution. But the opportunity to apply such treatment is extremely rare. The ulcer can only be thus aborted when it is palpably very superficial. Unless every bacillus is reached and killed by the acid, such cauterization manifestly does more harm than good. The presence of older lesions in the vicinity, therefore, contra-indicates this treatment.

Curative Treatment.—Three rules sum up the routine treatment of chancroid.

1. Establish the best possible surgical conditions by the treatment of complications (see below).

2. Clean the ulcers and dust twice a day with argyrol crystals. This is almost a specific.

3. Always suspect old, rebellious, or phagedenic sores of syphilis. Treat them locally by cauterization with carbolic acid or silver nitrate, if mild; by the actual cautery (under general anesthesia), if phagedenic.

Prevention of Bubo.—Warn the patient to avoid all violent exercise, and to walk about as little as possible in the hope of preventing suppurating bubo. Watch the groins carefully, and with the first sign of peri-adenitis (matting together of the glands) clap him into bed with a hot-water bag on his groin.

Do not, under any circumstances, paint the groin with iodin. It does no good and causes irritation of the skin, so that, if the bubo does eventually suppurate and burst, the surrounding skin is ready for inoculation.

Treatment of Complications.—*Cellulitis and suppuration* call for wet dressings, rest in bed, elevation of the penis, and incision, *secundum artem.*

Phimosis, whether congenital or inflammatory, is the most annoying complication of chancroid. A chancroid under a tight foreskin, unless aborted by argyrol, demands prompt liberating incision. Dorsal incision sometimes suffices; but a bilateral incision affords much more satisfactory access to sores in the region of the frenum.

After the chancroids have healed a secondary circumcision is usually required.

Above all things, do not pull back a tight prepuce. The *para-*

phimosis which will probably result is not easy to reduce, and is the most fertile cause of gangrene.

Partial erosion of the frenum forms a pocket which is very hard to clean. Tie a thread tightly around the remaining band, and it will cut through within forty-eight hours.

Suppurating bubo should be drained by very small incisions, almost punctures, multiple if need be, followed by injection of a 10 per cent iodoform-in-vaselin ointment. This injection is repeated every third day until the purulent discharge ceases. It invariably prevents chancroidal ulceration.

CHAPTER LXIX

GENERAL CONSIDERATIONS IN OPERATING ON THE URINARY ORGANS

The major operations upon the urinary organs are often performed upon patients whose kidneys are gravely diseased, and whose constitutions are more or less undermined, both by infection and by renal insufficiency. The following considerations are of importance, in the order given:

Complete diagnosis.
Improvement of the kidney action and reduction of sepsis.
Choice of anesthetic.
Choice of operation.

After the operation, the important special considerations are:

Facilitating the action of the kidneys.
Drainage (retained ureteral or urethral catheter).

DIAGNOSIS

The pathological conditions in the urinary organ of a patient who is about to submit to operation are often both multiple and complex. A patient with an enlarged prostate, for instance, may have both stone and tumor in his bladder (I once came upon one of my assistants endeavoring to do a litholapaxy under these circumstances); or he may have a saccule. If so, the removal of his prostate affords only partial relief. Pain and blood seen issuing from a ureter, with an x-ray shadow showing a stone on that side of the pelvis, might seem sufficient for a diagnosis of renal stone or ureteral stone. So it did in one of my cases; but the stone was in the appendix and had I taken the trouble to do a careful functional test I should have realized that it could not be in the urinary tract. When a patient passes a great deal of blood in the urine and has a very large kidney there seems little question but that the blood comes from that kidney; yet in one of my cases that had no pus whatever in the urine this free bleeding came from an ulcer on the papilla of a tuberculous kidney whose fellow was enormously hypertrophied but otherwise normal. A pain in the side preceding a calculous anuria would seem to justify operation upon that kidney.

I once followed this suggestion and, although I came upon a diseased kidney, at the post mortem examination the opposite kidney was found acutely obstructed by a stone in the orifice of its ureter. Had I operated upon the other side the patient would have been saved. A patient with advanced pulmonary tuberculosis and symptoms of surgical renal disease might be expected to have a tuberculous kidney. Yet from one such patient I have removed a kidney almost totally destroyed by tumor, and from a second a kidney containing the largest stone I have had to deal with. The tests made in this case showed a pyonephrosis with tubercle bacilli; omission of the x-ray led to overlooking of this very large stone. Such are some of the many pitfalls which may be avoided only by employing before operation every device to accomplish the most complete diagnosis possible.

The routine examination of every major urinary case includes the following items:

1. Complete urinalysis and physical examination.
2. Blood pressure.
3. Phenolsulphonephthalein test.
4. Radiography.
5. Cystoscopy and ureteral catheterization with kidney function test.
6. Other tests, such as pyelography or cystography, as may be suggested by the results of the preceding examination.

PREPARATION FOR OPERATION

General Preparation.—If the preceding examination has shown that the patient's general condition is such as to permit operation and that no special contra-indications exist the general preparation of the patient differs little from that for any other type of operation. A few points may be specified as follows:

1. The patient's skin should always be prepared by scrubbing, never by tincture of iodin. This must be the general rule for hospital cases inasmuch as a great many of them have to do with the genitals, and it is quite impossible to clean the skin of the scrotum by chemicals. It requires a thorough scrubbing after the patient has been anesthetized and is on the operating table.

2. The use of morphin either before or after operation is not contra-indicated by any renal condition with which I am acquainted. The drug does interfere with the activity of the kidney, but only temporarily. The advantage of the use of morphin often far outweighs its disadvantages. For instance, I have at present under my care a patient who is dying of cardiac decompensation in connection with a chronic pyelone-

phritis due to a stricture of the urethra. He recently passed but 2 ounces in 12 hours; he was then given ½ grain of morphin, slept 9 hours, and passed 10 ounces of urine in the subsequent 12 hours.

For several years past I have used hyoscin and morphin as almost a routine preliminary to operation.

3. Appropriate pre-operative treatment is required for diabetes, decompensated heart cases, high blood pressure and edema, etc. Rest in bed with appropriate drugs and diet will often put such patients in a condition in which they can be operated upon. The indications and contra-indications are in no way special for operation upon the urinary tract.

Preparation of Patients with Urethral Retention of Urine.—The pre-operative problem presented by the patient with urethral retention of urine has become classic in the treatment of sufferers from prostatism. But the prostatic is only a type, though often the most extreme type of this condition. Urethral stricture presents precisely the same problem, so does large vesical calculus; so, indeed, do certain renal conditions with low phenolsulphonephthalein output. But the problem of the prostatic summarizes all of these.

The preparation required by the prostatic depends upon the preliminary diagnosis; the following rules may be laid down:

1. The prostatic should never be operated upon while in acute retention. This retention must first be relieved by the retained catheter or by suprapubic drainage until the patient has passed through the acute reactionary congestion of the kidneys and the acute renal infection which inevitably ensue. This period used to be put at about one week. It is safer to prolong it until all subjective evidence of acute renal disturbance such as fever, dry tongue and disturbed mentality have disappeared, and further until the phenolsulphonephthalein test has shown a recovery from the first depression, which recovery may carry it back to a point even higher than it was at the time the catheter was first introduced into the patient's bladder.

2. We are accustomed to consider absence of infection almost as dangerous as the presence of retention. But this is probably only because the absence of infection and the presence of acute retention is a combination often seen, and an extremely dangerous one. If one operates between attacks upon a patient with a clean bladder and a retention of no more than 3 or 4 ounces of urine no undue inflammatory reaction or failure of the kidneys may be expected unless the phenolsulphonephthalein test before operation is extremely low. But the combination of an uninfected bladder and considerable retention is an extremely dangerous one. Prostatectomy upon such patients results in a very high mortality.

On the other hand the patient with a chronic retention and in so-

called catheter life is the safest possible risk for prostatectomy, unless his heart or his kidneys are worn out.

The Phenolsulphonephthalein Test.—The use of the phenolsulphonephthalein test as a pre-operative indication of the patient's condition is almost universal among American urologists today. As has already been insisted, however, the findings of the test are not absolute. If the phenolsulphonephthalein output in one hour after intramuscular injection is as high as 25 per cent and the patient is in no acute inflammatory or retentive condition, he may be estimated a good operative risk as far as his kidneys are concerned.

If there is considerable retention or acute infection, however, this must be overcome before the phenolsulphonephthalein assurance is accepted.

Yet a fine disregard of the findings of the phenolsulphonephthalein test may be expected of any accomplished surgeon. For in some cases the phenolsulphonephthalein output becomes and remains inexplicably low. This indicates damaged kidneys to be sure, yet the damage of the kidneys may not be so great as to prohibit operation. If such a patient has neither subjective nor objective symptoms of any acute condition, if his heart is reasonably sound or fortified by rest and digitalis, if the surgeon is skillful enough to perform his operation rapidly, and with a minimum of hemorrhagic and anesthetic shock, almost any operation may be performed in spite of almost any failure of the phenolsulphonephthalein test. As a rule such cases should show a low blood urea, though curiously enough they may at the same time show a low output of urea in the urine.

Preliminary Hexamethylenamin.—Although the virtue of hexamethylenamin as a pre-operative antiseptic is by no means definitely determined it is prudent to administer this in doses of at least 1 gram t. i. d., for one or two days preceding any operation upon the urinary tract.

Preliminary Diuresis.—Along with the hexamethylenamin it is wise to administer water to the point of obtaining 50 or 60 ounces of urine in the 24 hours preceding operation, and of reducing the specific gravity of this fluid to at least 1.015. The administration of water may, however, be overdone. The routine administration of large quantities of water is likely to result only in irritating the patient's bladder and in congesting the kidneys as well.

CHOICE OF ANESTHETICS

It is futile to lay down rigid rules on the subject of anesthesia. Every anesthetic is dangerous and each surgeon will succeed best with the anesthesia to which he and his assistants are most accustomed.

General anesthetics are said to be better given in this country than in Europe. The favorite anesthetic in this country at the present time is the gas oxygen method usually administered by the technic of Crile and often preceded by 1/200 of a grain of hyoscin and $\frac{1}{6}$ of a grain of morphin one hour before operation. I favor this preliminary narcosis as being free from danger and making the subjective operative shock much less for the patient; but I have unfortunately not yet met the ideal anesthetist to administer gas and oxygen without admixture of ether. It has been my experience that if this anesthetic is to be successfully administered it is best to anesthetize the patient with gas followed by ether (the so-called ether induction method) and then to proceed with gas and oxygen and as little ether as possible. But a truly skillful etherizer will do almost as well as the expert in gas-oxygen.

Though excellent authorities can be cited on either side, the prevailing surgical view today seems to be that ether is less disturbing to the kidney action than chloroform.

Local anesthesia should be substituted for general anesthesia wherever the skill of the operator with this method permits. Most scrotal operations can be performed under local anesthesia, though for inflammatory conditions I still prefer ether. Suprapubic cystotomy and lithotomy may perfectly well be done under local anesthesia and several surgeons have successfully performed prostatectomy by this method. I have not yet been converted to it. Local anesthesia is of no value for kidney operations excepting for the puncture of large hydronephroses or pyonephroses. European surgeons are employing paravertebral anesthesia for this purpose, and I have performed one nephrectomy by this technic. I am not convinced of its advantage over a good general anesthetic.

Sacral anesthesia has also been praised for operations about the pelvis. I have had no luck with it.

Spinal anesthesia I have employed about 200 times with 1 death due to anesthetic and 1 death possibly attributed thereto. This method of anesthesia has fallen into disfavor because of the great fall of blood pressure induced, especially if the anesthesia is carried high enough to permit an abdominal operation. For minor procedures it is objectionable because of the headache which is so likely to follow the spinal puncture. In the last year or two I have restricted its use to difficult cystoscopies. Sacral anesthesia may supplant it for this.

POSTOPERATIVE CARE

The patient's most crying need after operation is for water to promote free diuresis. This water may be administered while the patient

is still on the operating table through the stomach tube or by hypodermoclysis, or intravenous infusion. But these methods have of late years been supplanted by Murphy's drip method of administering water by rectum. This should be employed in all major surgical cases, whether failure of the kidneys is looked for or not. The drip should be kept up only long enough to insure free activity of the kidney. It may usually be stopped in 12 hours after operation.

As soon as the patient's stomach will hold it, the administration of hexamethylenamin is resumed in doses as high as the patient can bear and continued until all danger of acute renal infection has passed. As a routine measure it is not unwise to continue this drug for about a week after operation.

I believe in using morphin freely after operations, and do not feel that I have ever seen any harm result from this practice. The rest and relief from pain do far more good than the renal retention does harm.

DRAINAGE

Drainage is provided for in a special manner by the operative technic of each procedure to be described.

The Retained Catheter.—One of the most valuable ways of providing drainage for the bladder, both before and after operation, is by the retained catheter (indwelling catheter, catheter tied in, catheter *à demeure*).

The retained catheter or sound is employed either for dilatation or for drainage. For the former purpose, filiform bougies are tied into the urethra; for the latter purpose, silk or rubber catheters are employed. *No metal instruments should be tied into the urethra,* for fear of causing severe ulceration of the walls of the canal.

Antisepsis.—Before introducing the retained catheter, the anterior urethra should be thoroughly irrigated with a 1:4,000 solution of permanganate of potash, and the glans penis scrupulously cleansed with soap and water and bichlorid.

The *technic of the retained catheter* has been minutely explained by Guyon.[1] His rules may be summed up as follows:

1. The instrument employed should be large enough to permit a free outflow of urine, and small enough not to make any pressure along the canal. Its eye must be near the end. Metal and olivary instruments are useless. The simple rubber catheter or woven catheter should be employed.[2]

[1] "Leçons cliniques," 1897, iii, 328.

[2] We may add that special forms of self-retaining catheter are irritating to the male bladder, though they are favored for drainage of the bladders of women.

2. The instrument must be introduced so far as to have its eye well within the bladder. When the catheter is properly placed the urine flows continuously from it, drop by drop. When the retained catheter proves irritating this is usually because it has been introduced too far or not far enough, and is not draining the bladder properly.

3. The method of fixation is described below.

4. While the catheter is to remain in place the penis should be laid up over the groin, to prevent ulceration at the penoscrotal angle.[1]

5. Cleanliness is insured by using a clean catheter in the first place, by changing the catheter and cleansing it and the urethra every five days, by using daily irrigations of the bladder, by wrapping the penis in a wet dressing of bichlorid (1 : 10,000), and by using an aseptic urinal. An ordinary glass bed urinal will suffice. A rubber tube is led into it from

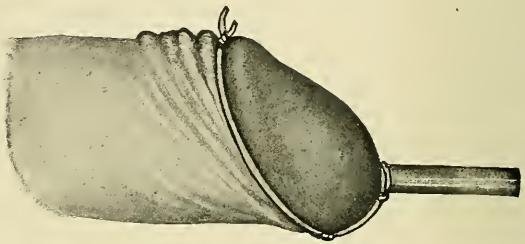


Fig. 141.—Filiform Bougie Tied On.

the catheter, and a little (1 : 40) carbolic solution kept in the vessel. The urinal is to be scoured and boiled daily.

When the retained catheter acts efficiently it reduces urinary fever and septicemia. When it acts inefficiently it produces them. Inefficient action may be due to plugging of the catheter by pus or blood, to malposition of the catheter, or to an idiosyncrasy of the patient.

Fig. 140. — Pezzer Self-retaining Catheter.

Fixation.—The female urethra is so short that an indwelling catheter in it must be of the self-retaining type (Fig. 140). Self-retaining catheters are of no value in the male urethra. In the female, the catheter is held in place by tying a number of silk strings to it as it issues from the vulva and fixing these to the pubic hairs in front, and by means of adhesive strapping to the lateral gluteal creases behind.

[1] This is not necessary if a soft rubber catheter is used.

Fixation in the male varies according to the instrument used. Fixation of a filiform may be accomplished by tying a silk suture about it as it issues from the meatus, tying the ends of this suture together at a point about 1 cm. distant from the bougie, and then running the ends about the coronary sulcus and tying them above (Fig. 141). A catheter is, however, too heavy to be held by this method. It may best be retained by the dressing devised by Dr. Sinclair.

Two pieces of adhesive plaster are cut into small rectangles, of which the long diameter will just surround the catheter, and the short diameter is about 1 cm. From the long edge of this rectangle two strips extend for about 10 cm. and are infolded so that they will not stick. The resultant product resembles a pair of trousers. The rectangles are affixed about the catheter close to the meatus, so that the "trouser legs" extend over the body of the penis at four equal angles. The shaft of the organ is then surrounded without compression by a band of adhesive plaster about 2 cm. in width, the legs of the catheter bands pulled down over this (Fig. 142) and fixed by means of another strip of adhesive plaster. Before this is made adherent, each of the legs is pulled taut. Brief compression then fixes the outer band of adhesive plaster over these. The solidity of the fixation is insured by wrapping a silk string three or four times about the adhesive plaster on the catheter and tying it tightly.

Fig. 142.—Sinclair's Method of Fixing Retained Catheter.

Position of the Penis.—If a silk catheter is used, the penis must lie over the groin; otherwise ulceration at the penoscrotal angle will result. If a rubber catheter is used, no attention need be paid to this detail, but the end of the catheter may be permitted to drop into a urinal situated between the patient's thighs.

Requisites for Success.—In order that the catheter shall work properly, it is necessary that it should fit loosely but snugly in the

urethra (about size 17 French); that its tip should remain in the bladder; and that it should be changed every three to six days, according to the irritation it excites. While the catheter is in place, the bladder should be irrigated at least once a day, and when it is changed the anterior urethra should be thoroughly flushed with permanganate solution.

The catheter always excites a mild urethritis, and sometimes great protestations of pain from the patient; but if the urine drips from it regularly, it is well to quiet the patient for the first twenty-four hours by assurances and narcotics, after which his objections will usually cease; but if the bladder persistently expels the catheter, or if the patient protests too loudly, or if fever results, it cannot be employed.

CHAPTER LXX

OPERATIONS UPON THE KIDNEY

SURGICAL ANATOMY

Gross Anatomy.—Although familiarity with the minute anatomy of the kidney is an essential part in the equipment of every practitioner, be he physician or surgeon, it is quite impracticable to enter upon this intricate subject here. A brief survey of the gross anatomy of the organ must suffice. The rest we leave to the histologist.

The kidney is ovoidal in shape, flattened anteroposteriorly, and with a deep notch, the *hilum,* in its inner border. The renal vessels and nerves enter the organ through the hilum, the vein lying in front of the artery, while behind these is the conical *pelvis,* terminating below in the ureter. The *sinus* of the kidney is the irregular cavity of which the hilum is the orifice.

The normal kidney is 11 cm. long, 6 cm. wide, and 4 cm. thick. It weighs from 125 to 200 grams.

The kidney is closely surrounded by a fibrous capsule sending fine processes between the secreting tubules. A thin, irregular layer of unstriped muscle lies between the capsule and the kidney. When the organ is healthy its capsule may be readily stripped from it, but inflammation causes the capsule to become adherent.

A vertical section through the kidney (Fig. 143) shows its secreting structure to consist of two parts: an outer (cortical) portion and an inner (medullary) portion, the latter made up of rounded cones (pyramids) whose apices (papillae, mammillae) project into the sinus of the kidney; while between the medullary pyramids the lighter-colored cortical portion of the organ also abuts on the sinus.

The Renal Arteries.—The *renal arteries* are given off one from each side of the abdominal aorta, and proceed directly outward to the kidney, lying behind the veins (the right renal artery runs behind the inferior vena cava). As the artery enters the hilum of the kidney it divides into several branches, which enter the cortical substance and are thence distributed throughout the organ. The arterial supply of the kidney is peculiar in that the vessels do not anastomose. The small vessels subdivide from the main branches that enter between the pyramids and are terminal.

Hyrtl has shown that the arterial system is divisible into two parts: a more important anterior system, supplied by the main branches of the renal artery, and a posterior system, supplied usually by a single branch, the retropyelitic, that passes around the posterior edge of the hilum, running down upon the posterior surface of the pelvis, and sends branches into the posterior part of the kidney. The terminal distribution of the anterior and posterior branches of the renal artery is neither definite nor fixed, but, generally speaking, the anterior branches supply a little more than the anterior half of the organ. Therefore, in order to incise as few arterial branches as possible, the kidney should be opened in a vertical line about 0.5 cm. back of the median plane of the organ.

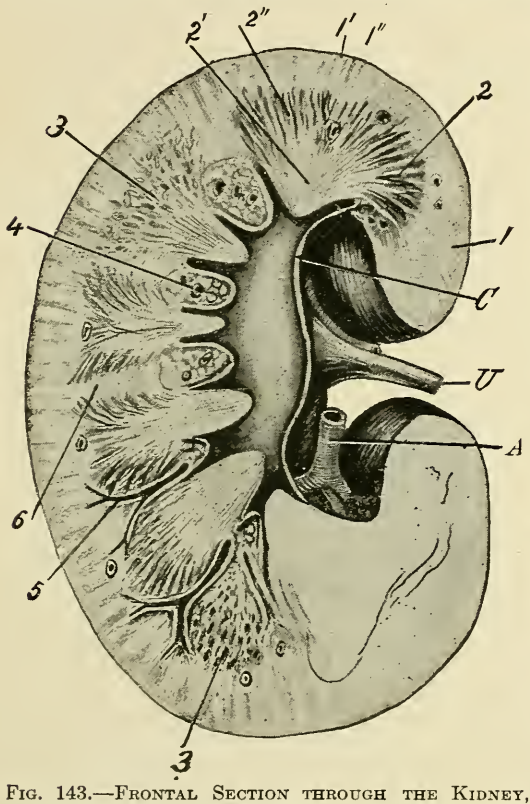


FIG. 143.—FRONTAL SECTION THROUGH THE KIDNEY, PELVIS, AND CALICES (Henle). A, branch of the renal artery; U, ureter; C, calyx; 1, cortex; 2′, medulli; 2″ boundary zone; 4, fat of sinus of kidney; 5, arterial branches.

VEINS, NERVES, LYMPHATICS.—The *renal veins* accompany the arteries, lying in front of them,[1] and empty into the inferior cava. On the left side, the spermatic, inferior phrenic, and suprarenal veins are tributaries of the renal. Within the kidney the veins anastomose freely.

The *nerves* of the kidney are derived through the renal plexus from the solar plexus, the semilunar ganglion, and the lesser and smallest splanchnic nerves. The spermatic plexus is derived from the renal plexus.

The *lymphatics* accompany the blood vessels and empty into the lumbar glands.

POSITION.—The kidneys lie on each side of the spine in the upper lumbar region, behind the other viscera and outside of the peritoneal

[1] Nuzurm (*Jour. A. M. A.*, 1914, lxii, 1238) has studied cases with retro-aortic left renal veins.

cavity (Fig. 144). They rest on the diaphragm and the psoas magnus and quadratus lumborum muscles between the twelfth dorsal and the third lumbar vertebrae. Their upper extremities lie nearer to each other than the lower, and the internal borders face a little downward and forward, the outer borders upward and backward. The right kidney often lies rather lower than the left on account of the position of the liver above it.

The average normal variation in the position of the kidneys is well expressed by Brewer's [1] statistics obtained in the dissecting-room. He found the upper end of the right kidney opposite the eleventh rib in 78 cases, opposite the twelfth rib in 62 cases, and lower still in 9 cases. The upper end of the left kidney was opposite the tenth rib in 1 case, opposite the eleventh in 100 cases, opposite the twelfth in 43 cases, and below the ribs in 6 cases. Yet it must be borne in mind that during life the kidneys move up and down with every respiration, and are peculiarly susceptible to downward displacement.

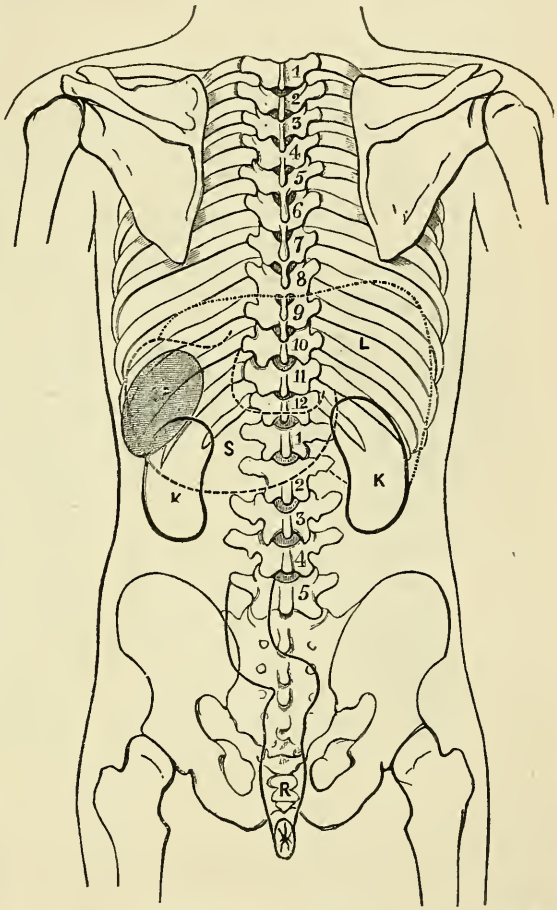


Fig. 144.—Diagram Showing Relation of the Viscera to the Parietes; Posterior View (Treves). S, stomach; L, liver; K, kidney; SP, spleen, R, rectum.

Fatty and Fascial Envelope.—The kidney, surrounded by its fibrous capsule and topped by the adrenal, lies embedded in a mass of loose cellular tissue, usually containing a considerable amount of fat, and calculated to permit slight changes in its size and position. This fatty envelope (perirenal fat) quite fills the hollow of the loin, and is surrounded and held in place by a distinct fascia. This fascia has been

[1] *Med. News*, 1897, lxxi, 129.

studied by Zückerkandl, Gerota, and Glantenay and Gosset.[1] It completely surrounds the kidney, the suprarenal capsule, and the perirenal fat. In front it blends with the subperitoneal fascia, internally it adheres to the vertebral column, and above to the diaphragm. It sends a few fibers to the aponeurosis of the quadratus lumborum which lies immediately behind it. It thus forms a distinct sac firmly anchored to the diaphragm and the spine. It is everywhere closed, except at its

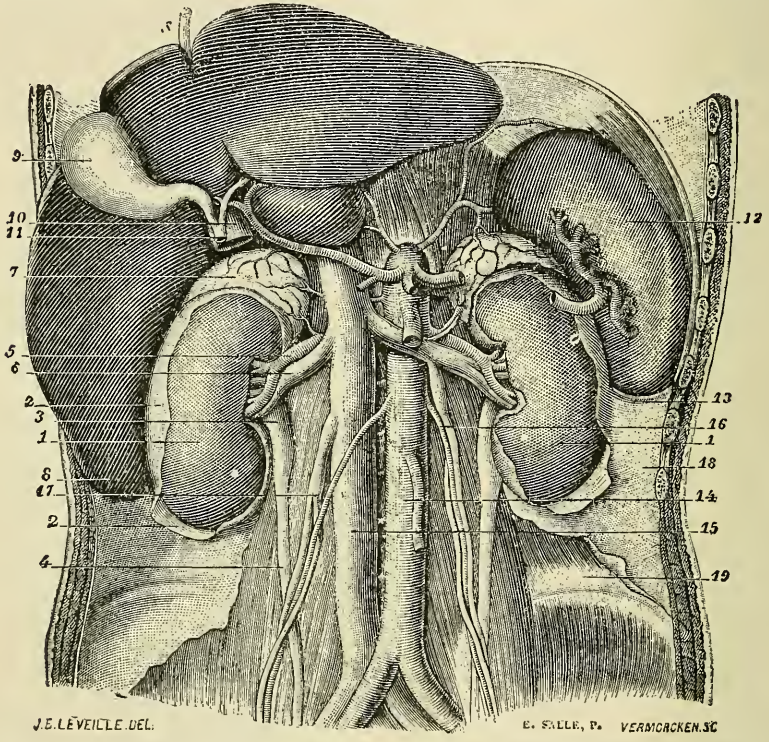


FIG. 145.—SITUATION, DIRECTION, FORM AND RELATIONS OF THE KIDNEYS (Sappey). 1, 1, the two kidneys; 2, 2, fibrous capsule; 3, pelvis; 4, ureter; 5, renal artery; 6, renal vein; 7, suprarenal capsule; 8, the liver lifted up; 9, gall-bladder; 12, spleen; 14, abdominal aorta; 15, inferior vena cava; 16, left spermatic artery and vein.

lower extremity, where the posterior layer thins out and sends only a few fibers across to the subperitoneal fascia. Below and behind this fascial envelope lies another mass of fat, practically continuous with the perirenal fat, but distinguished as the *pararenal fat.*

RELATIONS.—Behind, the kidney is in relation with the diaphragm and the psoas and quadratus muscles. The last dorsal nerve runs transversely between the muscles and the perirenal fascia, and the pleura usually descends between the ribs and the diaphragm low enough to cover the upper third of the organ.

[1] *Guyon's Annales,* 1898, xvi, 113,

In front of the right kidney lie the duodenum and the ascending colon. A fold of peritoneum separates kidney and liver above the colon, while lower down a peritoneal fold separates colon and duodenum.

The left kidney is crossed by the tail of the pancreas and lower down by the descending colon, while its upper portion is separated from the stomach by the lesser sac of peritoneum.

The upper extremity of each kidney is capped by the adrenal. In fetal life this is closely adherent to the kidney and almost completely envelops it, but after birth the adherence becomes slight.

The Pelvis of the Kidney.—The pelvis belongs anatomically to the ureter, of which it is the dilated upper extremity, but surgically to the kidney, of whose secretion it is the reservoir and in whose surgical disease it participates.

At the bases of the renal pyramids the epithelium of the uriniferous tubules joins with the fibrous covering of the cortex, the one to form the inner, the other the outer, coat of a tube surrounding one or more papillae, and called a *calix* (infundibulum). The calices unite to form the pelvis, an irregularly funnel-shaped pouch which protrudes from the lower and back part of the hilum, whence it runs downward, narrowing rapidly to become the ureter proper at a level with the lower end of the kidney.

The structure of the pelvis resembles that of the ureter (p. 451).

The radiographs, Figs. 36 and 37 and Plate V, illustrate the great diversity in shape and size of the normal kidney pelvis.

Generally speaking, the pelvis splits up into two main calices; the upper one long and thin, extending obliquely upward to the top of the kidney, the lower one shorter and thicker, extending transversely. Each of these subdivides into several secondary calices, as the illustrations show. Manifestly, therefore, when the kidney is incised for the purpose of reaching the pelvis, it is wiser, other things being equal, to make the incision in the lower pole, both because the lower calix is broader and more readily accessible, and also because it is usually large enough to admit the finger, which the upper calix may not be.

Relations of the Vessels to the Kidney Pelvis.—The main renal vessels lie in front of the kidney pelvis and extend from the kidney in a direction upward and inward, while the pelvis, which lies behind, drops almost directly downward. The only vessel of importance lying behind the pelvis is the retropyelitic artery, which, as stated above, supplies the posterior portion of the kidney. Inasmuch as there are no internal anastomoses in the renal arteries, division of this artery may occasion necrosis of almost half the kidney. It is, therefore, important to be on the lookout for it whenever the pelvis is incised. It usually skirts the upper edge of the pelvis within the hilum of the kidney, so that, ordinarily speaking, it is not seen.

PREPARATION FOR OPERATION

The preparations for operation upon the kidney are, generally speaking, those for any major, general operation. The patient's general condition should be in the best possible state, and the diagnosis of the state of the renal function, of the pathological condition of the kidneys and of the condition of the other vital organs, should be most carefully studied.

The study of the renal function should be made as previously laid down, and it is an excellent rule to perform radiography, ureteral catheterism, and study of the renal function upon every patient whose kidney is to undergo operation. Under certain circumstances any or all of these tests may have to be omitted, but one can never tell beforehand which is the case that may absolutely require every diagnostic test. The recent confession of a noted surgeon that, in his second series of 100 operations upon the kidney, he was mistaken in his diagnosis quite as many times as in the first 100 cases, is but an expression of the great uncertainty of renal surgery, which uncertainty can only be lessened by familiarity with and constant application of every device for accurate diagnosis before the patient comes to the operating table. (See Chapter LXIX.)

LUMBAR INCISION

Position of the Patient.—For such minor operations as drainage of perirenal accumulations of pus and urine, or nephropexy, the patient may lie upon the abdomen, since the operation may be performed through a vertical dorsal incision, but the only advantage of this position is that it saves a little time if both kidneys are to be operated upon. The almost universal custom is to place the patient upon one side, with the hip and knee of the under leg well flexed so as to prevent the trunk from tumbling over, and the knee and hip of the upper leg extended, for the purpose of retaining the balance and of still further increasing the size of the lumbar recess. To increase the size of this space still further, and to push the kidney upward and make it more accessible in the loin, it is necessary to place some form of pillow or bolster underneath the opposite loin of the patient. A large sand bag or pillow will serve this purpose; the Edebohls kidney bag serves better; and the appliances for this purpose fitted to all modern operating tables serve best of all, since these may be raised or lowered and the patient, placed upon the flat table, may be raised into proper position during the operation, and dropped back upon the table again when the muscles are to be sutured. The elevation should be such as to put the upper loin upon the stretch, but not really to lift the weight of the patient's body from

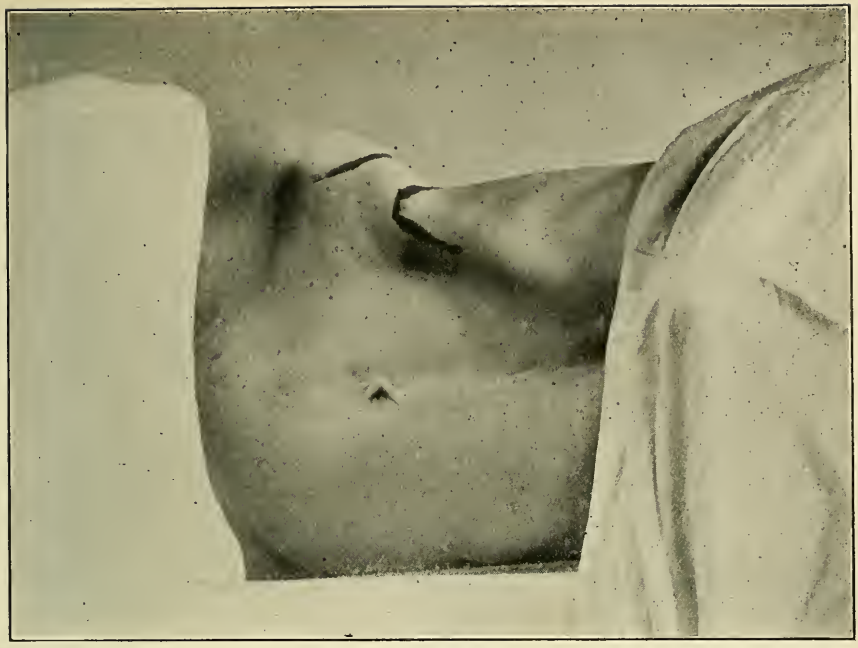


Fig. 146.—Patient Lying on Side, Showing Proximity of Free Border of Ribs to Crest of Ilium.

Fig. 147.—Patient as in Fig. 146, but Elevated by "Kidney Support." Note how the ribs are drawn away from the iliac crest. The space between is widened by the interval included in the ◘.

the hip and shoulder resting on the table. The arms should be disposed in front of the patient.

The Incision.—Three incisions are in favor. In the order of importance they are:

The oblique incision.
The transverse incision.
The vertical incision.

The Oblique Incision.—The surgeon, standing behind the patient, determines the position of (1) the tip of the last palpable rib (which may be the eleventh or the twelfth); (2) the outer edge of the mass of spinal muscles; and (3) the upper border of the iliac crest. The incision is begun over the rib at the point where it disappears under the erector spinae, and carried obliquely down and forward to pass two or three fingers' breadths above the upper edge of the iliac crest, from which it can be carried still farther down and forward parallel with that crest, if necessary. The incision should always be long enough to admit the whole hand. It may be curved slightly with the concavity upward.

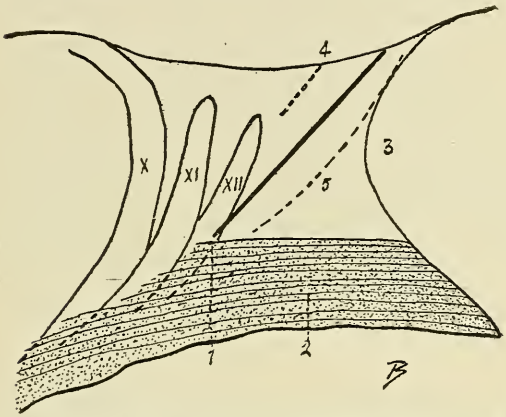


Fig. 148.—The Oblique "Kidney" Incision. 1, costomuscular angle; 2, quadratus and spinal muscles; 3, iliac crest; 4, last dorsal nerve; 5, iliohypogastric nerve; x, xi, xii, ribs.

After incising the superficial tissues, the external oblique is reached and divided; though if an easy operation is anticipated, this muscle may be thrown forward and the dissection continued between it and the spinal muscles in Petit's triangle. The next plane reached is that of the internal oblique and transversalis. If the kidney is known to be very loose, these muscles need not be divided, but may be separated on a plane parallel with their fibers.

This muscle-splitting operation gives, however, a very restricted field, and in the great majority of instances it is necessary to divide all the abdominal muscles in line with the external incision, the transversalis being split parallel to its fibers. If the division is made sufficiently far back, the twelfth dorsal nerve is not seen; if the incision is sufficiently oblique and high above the iliac crest, the ilio-inguinal and iliohypogastric nerves are either not seen at all, or are seen to run parallel with the incision and below it. None of these nerves should be divided.

Unless the kidney is very low the incision should now be carried upward along the lower border of the twelfth rib (after making sure that it *is* the twelfth and not the eleventh—otherwise the pleura will be torn). The latissimus dorsi is divided, and the rib freed from the serratus posticus inferior and the erector spinae and finally from the ligament of Henle, a fibrous band binding it down to the first lumbar vertebra. (These structures should be incised at a little distance from the rib; otherwise the last dorsal vessels will be repeatedly incised. They may then be divided and tied once, well away from the rib.) With the cutting of this ligament the rib will be felt to spring away from the vertebrae, thus greatly enlarging the lumbar space.

Now a mass of retroperitoneal fat appears in the incision. This is pushed down and blunt dissection made in a backward and upward direction. This brings the perirenal fat into the wound, surrounded by its fascial capsule. Since this fascial capsule closely resembles the peritoneum, the surgeon will do well to thrust his hand into the incision along the muscles of the back, and then, palpating forward, he will feel the kidney, and be sure that the tissue behind it is its fascial capsule. This fascial capsule is incised and split longitudinally by the fingers.

If the kidney is quite loose, it may be drawn into the wound by catching the perirenal fat which now bulges out, and drawing it out, both in front and behind, while the fingers strip it from the surface of the kidney; but if the kidney is adherent, this procedure is of no avail. The hand must be plunged into the loin and blind, blunt dissection made with the fingers.

The first object sought is to clear away the upper pole of the kidney. With the fingers close to the organ, adhesions are broken up and the perirenal fat pushed aside until the upper pole is reached; then the fingers are swept around this, both behind and before, until it is quite free. The upper pole is then released and the lower pole much more readily freed in like manner. In freeing the poles one should delay a moment to feel for aberrant vessels.

An attempt is then made to draw the kidney up into the wound, either by traction upon the perirenal fat and capsule, or by traction upon the kidney itself. If the maneuver is difficult, it may often be facilitated by turning the kidney backward, inspecting its anterior surface, and carefully incising adhesions that bind it to the surrounding tissues, pushing these away and so advancing, little by little, until the hilum is reached. The same procedure is then employed for the posterior surface of the kidney, and for its extremities as well. Finally, when all adhesions have been freed, the kidney readily pops out of the wound, unless bound down by considerable inflammation about its hilum.

The Transverse Incision.—This incision is employed for the removal of unusually large kidneys. It is carried parallel to the last rib, and a finger's breadth below it from the edge of the spinal muscles to the edge of the rectus. Nephrectomy is then performed as described on p. 697.

The Vertical Incision.—The vertical incision, running directly downward from the twelfth rib to the iliac crest, gives a field too restricted for most operations. It may be employed for nephropexy, and has the advantage of sparing the lateral and anterior abdominal walls.

Variations in the Operation.—Many other types of incision have been suggested, but the three mentioned above are the only ones currently employed.

The oblique incision may be extended downward, for extraperitoneal exploration of the ureter, as far as the brim of the pelvis. If intraperitoneal complications are suspected, the peritoneum may be deliberately incised and the gall-bladder, the intestines, or even the appendix, inspected, while the hand may be run across for intraperitoneal palpation of the opposite kidney—a procedure, by the way, which very rarely discloses anything worth knowing. That the opposite kidney seems sound on palpation is no evidence that it has any appreciable functional capacity.

Accidents in the Operation.—*The peritoneum* may be torn, but this is an unimportant accident, even if it cannot be adequately sutured. If the kidney or the perirenal tissues are infected, peritonitis may be prevented by adequate drainage.

Injury to *the pleura* is prevented as described above. Its occurrence is characterized by the whistle of the air drawn in at inspiration and the bubbles that appear in the wound at expiration. The tissues should be quickly clamped and the rent closed by suturing the diaphragm. Other operative accidents relate to the kidney and are mentioned in the succeeding chapters.

THE TRANSPERITONEAL INCISION

Deliberate transperitoneal nephrectomy through a vertical incision at the outer edge of the rectus muscle is no longer an approved operation. It is employed only when the surgeon, ignorant of the precise nature of the abdominal mass he is attacking, enters the peritoneal cavity before he recognizes that the kidney is the organ at fault. Under these circumstances if the mass is not infected it may be attacked in the way most convenient. If it is infected the peritoneal cavity may be readily walled off either by suturing the parietal peritoneum and then dissecting it laterally until the tumor is reached extraperitoneally,

or by making a vertical incision in the peritoneum, just lateral to the ascending or descending colon, and suturing this layer of parietal peritoneum to the inner edge of the peritoneal incision of the anterior abdominal wall. For a proper handling of a renal growth under these conditions it is usually necessary to enlarge the vertical incision by a transverse one extending to the loin.

A much more common form of intraperitoneal operation is that which begins as an extraperitoneal procedure in the loin, but enters the peritoneum either accidentally or deliberately on account of difficulties in removing the kidney. Such an opening in the peritoneum need not be deplored since it often gives more ready access to the inner side of the mass, and guarantees the safety of the colon and the vena cava. The intestines are simply walled off, and the operation proceeds in the usual manner as described on page 694.

CHAPTER LXXI

OPERATIONS UPON THE KIDNEY (*Continued*)

NEPHROTOMY

The Operation.—The kidney is laid bare through the oblique lumbar incision in the manner described above.

The vascular pedicle is then compressed[1] by means of a long intestinal clamp with blades protected by rubber tubing. In placing the clamp, care should be taken to *avoid the ureter,* and for this reason it is better, if possible, first to free the ureter from the mass of the renal pedicle and then to place the clamp. The kidney is now incised according to the indications of the particular case in question. Other things being equal, *the incision* should always be made parallel to the long axis of the kidney and preferably about 5 mm. ($\frac{1}{4}$ inch) posterior to its median line, since this is the region that contains least blood vessels. Unless there is some special indication for opening the superior calyx, the best incision is that devised by Albarran:

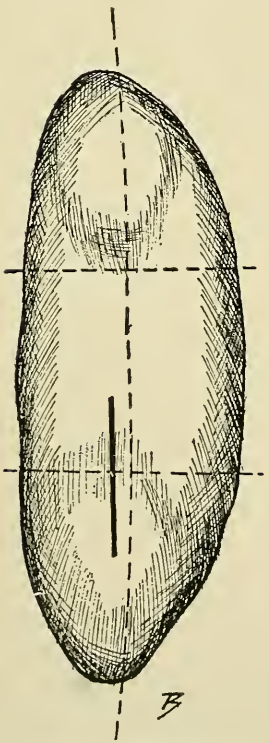


FIG. 149.—NEPHROTOMY INCISION.

With a plunge of the bistoury to the depth of 3 cm., the surgeon incises the convex border of the kidney 5 mm. back on its posterior surface. The incision should begin 2.5 cm. above the junction of the middle and inferior third of the kidney, and is prolonged for an equal distance below that point. Separation of the wound surfaces exhibits the section of the gray mucous membrane of the inferior calyx, which has been opened. This opening is enlarged with the scissors sufficiently to admit the finger without tearing the kidney tissue. It may be enlarged from end to end of the kidney if necessary.

[1] It has been demonstrated (cf. *Trans. Am. Assn. Gen.-Urin. Surg.,* 1909, vol. iv) that compression of the renal pedicle, especially by instruments, causes anuria which may last many hours. But Eisendrath and Straus (*Jour. A. M. A.,* 1910, lv, 2286) have shown that the vessels may be occluded with safety for half an hour.

The "silver wire" method of nephrotomy is the following: A long, blunt slightly curved needle armed with a stout silver wire is plunged into the kidney pelvis just at the lowest point of the posterior lip of the hilum, pushed up to the tip of an adjacent calyx and so out through the dorsum of the kidney, just behind its median line. The points of entrance and exit are then joined by using the wire as a Gigli saw. The needle is then re-introduced and brought out at the uppermost calyx and the kidney laid open from end to end. This method was expected to minimize the resultant hemorrhage, but it does not seem to have come into very general use.

The finger is then introduced into the pelvis of the kidney, whence it can be passed well up into the superior calyx and the whole interior of the organ be explored, counterpressure being made from without. If there is question of the permeability of the ureter or of the presence of stone in that duct, a ureteral catheter is passed down into the bladder. The catheter must pass at least 35 cm. before one can be sure that it has actually entered the bladder.

This investigation is sufficient to disclose stone in the urinary passages, but not to determine absolutely the presence of such a lesion as an ulcerated papilla or a very small neoplasm. If this is suspected, but the pre-operative diagnosis has not been absolute, the kidney may be split from end to end and carefully examined.

Suture of the Kidney.—If the kidney is known to be uninfected, it may be sutured without drainage. If infection is known to exist, or is feared, it should be sutured around a small rubber drainage-tube.[1]

To close the kidney incision, heavy, plain catgut sutures should be passed through and through on a large, curved needle, in such a way as to penetrate to the depth of the wound. These sutures should be placed about 1 cm. ($\frac{1}{2}$ inch) apart. After they have been placed the pressure on the renal pedicle is released, the two edges of the wound pressed tightly together, and the sutures tied firmly enough to control hemorrhage but not tight enough to cut through the parenchyma. If heavy catgut is not at hand, a doubled strand of light catgut may be used for each suture. Between each of these deep sutures the line of incision is then further closed by the addition of a superficial suture which penetrates only about 1 cm. into the kidney. The kidney is then returned to its place in the loin, a small drainage-tube inserted down to the kidney, and the abdominal wound sutured.

A second tube is then introduced down to the kidney to drain the perinephritic space, and the parietes closed in layers.

Postoperative Treatment.—The only special requirement is that the tube in the kidney be left in place until all hemorrhage has ceased—

[1] Cunningham has shown that in dogs postoperative anuria lasts much longer if the kidney is sutured than if drainage is employed.

at least three days. If the ureter is not obstructed the urinary fistula will heal within the week.

Postoperative Complication.—The only peculiar postoperative complication is hemorrhage. Although the hemorrhage resulting from incision of the kidney is alarming to the unaccustomed surgeon, it may be thoroughly controlled by compression of the pedicle and by the subsequent suture of the organ, unless the kidney is chronically inflamed; but prolonged chronic nephritis produces changes in the organ which make it bleed profusely and make this bleeding very difficult to stop. In not a few instances, postoperative hemorrhage has either carried off the patient or called for immediate secondary nephrectomy under most trying circumstances. For this reason pyelotomy is, whenever possible, preferable to nephrotomy.

PYELOTOMY

The kidney is exposed and liberated as usual. After it has been brought up into the loin, palpation of the region immediately beneath its lower pole along the peritoneum reveals the cordlike ureter. The fascia is stripped from the posterior surface of the upper part of the ureter, leaving it attached in front to the peritoneum, and the fascia is also stripped from the posterior surface of the pelvis of the kidney, care being taken to avoid the retropyelitic artery. The pelvis is now incised in a line radiating from the mouth of the ureter toward the hilum of the kidney. This incision is made large enough to admit the little finger of the surgeon, with which the interior of the cavity of the pelvis is then explored. Through this same incision stones may be extracted and a ureteral probe may be passed down into the bladder.

The wound in the pelvis is closed by fine catgut sutures through and through. There is rarely any need to drain the pelvis, but this may be done by means of a small catheter without fear of resulting fistula. A drainage tube is always left in the perinephritic space.

Wounds of the pelvis of the kidney may be expected to heal by first intention, if properly sutured, but a tube should always be run down to the site of the suture for fear of a break. Urinary fistula from the pelvis is not likely to continue for more than two weeks. Healing may be hastened by the indwelling ureter catheter.

NEPHROPEXY AND DECAPSULATION OF THE KIDNEY

The Operation.—The methods of performing nephropexy are innumerable.[1] The essentials to a good operation are:

(1) All of the perirenal fat between the kidney and its fascial en-

[1] Luzior ("De la Nephropexie," Paris, 1913) has described 51 methods.

velope should be removed, in order that the kidney may form adhesions with the parietes which shall hold it tightly in place; (2) the kidney should be fixed in such a way that its position shall be as normal as possible, its ureter and vessels not kinked, and itself held as high as possible up under the ribs; (3) the sutures by which the kidney is held should not so restrict its mobility that its vessels may become kinked after operation; (4) sutures should not pass through the kidney tissue itself, but the organ should be held in place by sutures passed through its capsule.

Edebohls's Operation.—The method of Edebohls is the one now almost universally employed. The operation was performed by Edebohls through a vertical incision; but the oblique incision may be employed. The perineal fascia is then incised and pulled well up into the wound, the fat separated from the kidney before and behind and carefully excised, leaving only the fascial capsule surrounding the kidney.

Decapsulation.—The kidney is then decapsulated as follows:

A small nick is made in the capsule in the median line near the lower pole. A grooved director is passed through this incision between the capsule and the kidney, and upon it the capsule is slit from one pole to the other along the convex border. Each edge of this incised capsule is then freed from the surface of the kidney by blunt dissection. Two suspension sutures are then placed through the capsule at its point of reflection from the kidney, without penetrating the kidney tissue. The kidney is then replaced in the loin and, if necessary, a little separation is made of the tissues at the upper end of the kidney recess, in order to permit it to pass freely up under the ribs. Either before or after the kidney is replaced, the pelvis and ureter are carefully inspected to see that they are not compressed or kinked by adhesion to the lower pole of the kidney. The suspension sutures attached to the kidney capsule are then passed through appropriate portions of the parietal muscles and tied.

According to the original Edebohls method, the sutures were of silkworm gut, and were carried up through the skin of the loin to be cut and withdrawn after healing had taken place; but it seems preferable to employ chromic gut and to bury the sutures. In tying the sutures, one must, of course, be careful to tie the ends of each loop to each other.

NEPHROSTOMY

Nephrostomy is an operation upon the kidney for the purpose of deflecting the urine through the loin for a greater or shorter length of time.

Nephrostomy of Calculous Anuria.—The object of this operation is to drain the kidney rather than to remove the calculus. Watson urged the performance of simultaneous double nephrostomy for this condition, and if the condition of the other kidney is doubtful, this is the operation of choice. On account of the patient's precarious condition, the operation should be made as brief as possible, and if any difficulty is experienced in finding or removing a calculus, this should be deferred to a subsequent operation.

Nephrostomy for Nephritis.—For *chronic nephritis* the operation of decapsulation is commonly preferred to that of nephrostomy, since it achieves approximately the same ends without destroying any of the renal parenchyma. If nephrostomy and decapsulation are performed at the same operation, care must be taken to leave enough capsule along the convex border of the kidney to hold the sutures, for these will otherwise tear through the soft parenchyma (Fig. 150).

Nephrostomy for Hydronephrosis.—Operation upon a hydronephrotic kidney is always undertaken for the purpose of relieving the obstacle. If this cannot be done, and the condition of the opposite kidney is doubtful, it may seem wise to perform nephrostomy; but if the opposite kidney is in good condition and the ureteral obstruction cannot be relieved, it is wiser to remove the dilated kidney.

Nephrostomy for Pyonephrosis.—When operating upon pyonephrosis in a patient whose opposite kidney is in a condition of doubtful vitality, or known to be gravely diseased, nephrectomy cannot be performed.

Albarran advises that the fatty capsule should only be partly stripped away from the kidney, in order to avoid the possibility of pocketing of pus. The incision into the kidney itself is made, if possible, over a soft spot where the parenchyma is thin. The finger explores the interior of the pelvis, extracts any calculi that are found there, and opens badly draining pouches freely into the general cavity of the pelvis. The parenchyma is then sutured about a drainage tube.

The kidney is drained until the patient's condition shall have considerably improved, when a secondary nephrectomy may be performed.

To close the operation, the lips of the kidney incision are partially sutured, while the remainder of the kidney incision is sutured to the muscles of the loin, in order to prevent pocketing of pus. Rubber-tube drainage is required. If the perirenal fat has been torn away freely from the kidney, extrarenal drainage must be provided as well.

The tubes are left in the kidney so long as pus in any quantity continues to drain through them.

Nephrostomy for Tuberculosis.—This is an operation to be employed only as a last resort, when both kidneys are known to be gravely

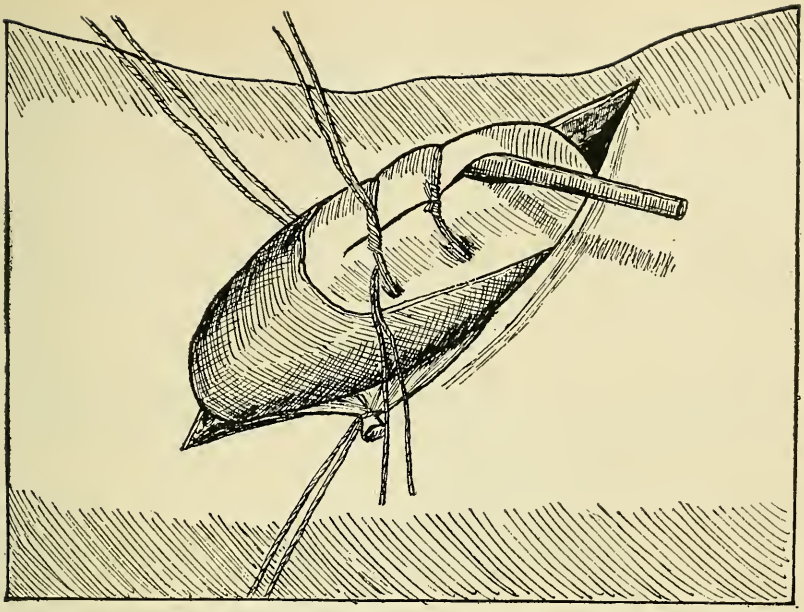


Fig. 150.—Nephrotomy with Decapsulation. A section of the capsule is preserved to hold the kidney sutures. The remainder is turned back and caught in a suspension suture for nephropexy. (After Albarran.)

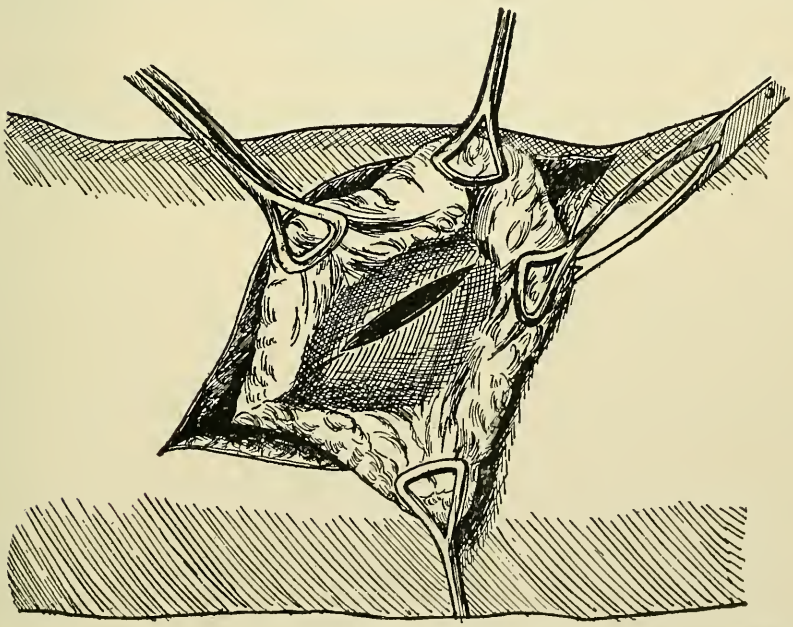


Fig. 151.—Restricted Liberation of Perirenal Fat in Nephrostomy for Pyonephrosis. (After Albarran.)

affected with tuberculosis, and one of them is causing an active sepsis. The drainage must be made permanent.

Nephrostomy Preliminary to Operation upon the Bladder.—In Watson's operation for drainage of the kidney preliminary to removal of the bladder, the surgeon's object is not to make a fistula that will soon close, but to make one that will remain permanently open.

> The only difference between the ordinary nephrotomy and the operation by which a permanent drainage of the kidney is arranged, consists in attaching the edges of the renal incision to those of the lumbar wound. This is done by placing a row of mattress sutures on either side of the incision . . . after which the kidney and lumbar incisions are brought together by another row of sutures, thus closing them around the drainage tube. The latter is at first held in place by a stitch passed through it and through the skin at the point at which the tube emerges from the surface. (Watson.)

Apparatus for Drainage.—Whenever nephrostomy is done, urine, or urine and pus, run from the wound in large quantities and often for a considerable time. It is, therefore, necessary to provide the patient with an apparatus that will dispose of this outflow while he is moving about.

A patient of mine is now wearing a silver tube, to which is attached a silver disk 3 inches in diameter, to rest against the skin, while the end of the tube is turned down at a right angle, and from it a short rubber tube leads into a leg urinal. For certain cases, the apparatus of Watson may be more convenient.

NEPHRECTOMY

There are three types of total nephrectomy: the one applicable to all cases usually encountered, excepting tumors; the second applicable to very large kidneys, whatever their nature; the third employed for the removal of malignant neoplasm. The first, or *usual type of nephrectomy,* is performed as follows:

The kidney is exposed and brought into the wound in the usual manner, the ureter is then identified running down from the hilum of the kidney against the peritoneum. It is readily liberated by blunt dissection or one or two strokes of the knife, doubly clamped and divided by the actual cautery. If the ureter is tuberculous as much of it is removed as possible. The stump is then ligated, the clamp removed, the tip once again touched with the cautery, and dropped back into the wound.

The surgeon next turns his attention to slowly and methodically clearing the renal vascular pedicle of fat and fascia. If the pedicle is uninflamed this may readily be done and the individual vessels may

even be separately caught and ligated before they are cut. But if the fascia of the pedicle has become infiltrated as the result of prolonged suppuration in the kidney it may be difficult either to separate the pelvis of the kidney behind or the surrounding fascia from it on all sides. A persistent but gentle effort to clear the pelvis should always be made, for if this is not cleared before the clamps are applied to the pedicle a piece of its mucosa may be included in the stump and encourage subsequent fistula, especially if it be tuberculous. After clearing the pedicle as much as possible it is clamped from above down-

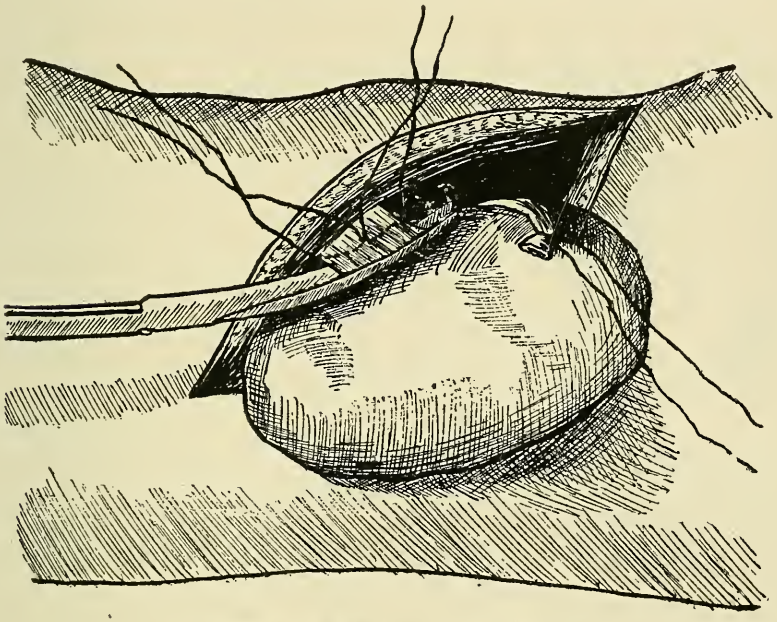


Fig. 152.—Nephrectomy. (After Albarran.)

ward in order that the renal artery may be firmly caught in the heel of the clamp. The kidney is then tilted backward and the pedicle cut away between it and the clamp. If the kidney is tuberculous one should fill the wound with large gauze pads before cutting the pedicle since the blood effused may well be loaded with tubercle bacilli as the result of the manipulation of the organ.

Ligature of the pedicle is usually the one difficult problem of nephrectomy, for the clamp holds the tissues of the pedicle so spread out that a ligature tied on the vessels near the clamp will frequently slip from them when this is removed. This may be avoided by transfixing the pedicle towards its lower part (so as surely to avoid the artery) and tying it in two sections. Over this ligature a second ligature is then applied and its ends knotted once, tension being made upon

them as the clamp is taken off. One will immediately feel the tissues of the pedicle shrink within the ligature which is then pulled tight and the second knot fastened. Mayo [1] whenever possible puts two clamps on the pedicle and places his first ligature proximal to the proximal clamp, ties it loosely, removes the clamp, and ties it tightly in the groove made by the clamp. Even this type of ligature should be fortified by a second piece of catgut before the second clamp is removed.

But some pedicles are so thickened and shortened by inflammation that it is truly prudent not to waste time in endeavoring to ligature them in any of the above methods. Much time may be wasted in the effort to remove the clamp and in the end the surgeon may well find that he has four or five clamps left on his pedicle instead of one, and this in a case that is likely to be especially sensible to loss of blood and prolonged anesthesia. I deliberately leave the clamp on such pedicles which used to constitute about half and now constitute one in five of the nephrectomies I perform. The clamp should be removed on the fourth day. I have left clamps on at least twenty cases and have never seen any hemorrhage at the time of their removal (though I have taken many of them off on the third day) with the exception of one case whose renal vein had been torn. In this instance I opened the clamp on the third day and a sharp hemorrhage ensued. I reclosed the clamp and the hemorrhage stopped. Two days later the same performance was repeated, but on the seventh day the opening of the clamp was not followed by bleeding, and it was safely removed.

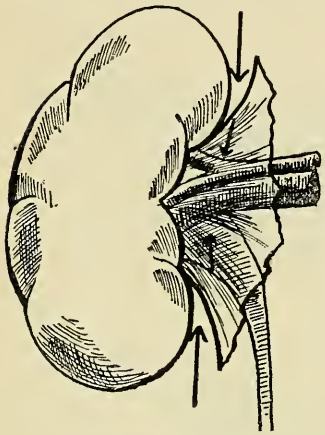


Fig. 153.—Showing How the True Pedicle Is Obscured by the Fibrous Capsule in Subcapsular Nephrectomy. (After Albarran.)

Subcapsular Nephrectomy.—It may be impossible to liberate a densely adherent pyonephrotic kidney from its bed without repeatedly tearing its fibrous capsule. In this event the easiest way to free the kidney is deliberately to decapsulate it. Traction on the kidney then turns the capsule inside out, shrouding the ureter and vessels (Fig. 153). The circumcision of this capsule close to the hilum brings the true pedicle into view.

Disposition of the Tuberculous Ureter.—The total removal of the ureter with the kidney for tuberculosis is an operation that still proves tempting to many surgeons. The ureter is obviously tuberculous; hence its total removal seems indicated. But total removal in the sense of

[1] *Jour. A. M. A.*, 1915, lxiv, 953.

removing all the tuberculosis in the ureter and the bladder beyond is never contemplated and the clinic has shown that the stump of the ureter will usually take care of itself. Exceptionally it opens up and discharges urine from the bladder back into the wound (I have only once seen this happen) and Mayo states that about 5 per cent of tuberculous ureters should be removed because they are dilated above a stricture.

I have never removed a tuberculous ureter, nor have I ever seen the ureter become cystic after nephrectomy as a result of accumulation of its own secretions within it.

Such a ureteral cyst has, however, been encountered a number of times and required preliminary drainage and later excision of the sac.

Drainage.—Mayo believes that by filling the loin with saline solution in order to displace the air in the wound, and suturing the wound tightly a fistula is less likely to follow nephrectomy for tuberculosis than if drainage is employed. After following this technic in perhaps 20 cases, I cannot see that it has diminished the number of postnephrectomy fistulae. It seems quite as satisfactory to treat the tuberculous nephrectomy wound quite like any other loin wound by drainage with a small tube.

NEPHRECTOMY FOR LARGE KIDNEYS

Neoplasms require a special type of nephrectomy to be described below. Nephrectomy for large tumors other than neoplasm differs from the operation described above chiefly in that the incision employed should be transverse rather than oblique with a little hook up over the twelfth rib where it is covered by the erector spinae muscle. The rib is freed as usual and the transversalis and other abdominal muscles divided up to the edge of the rectus, the line of incision being about two fingers' breadth below the tip of the last rib.

This may be still further enlarged if necessary by a vertical incision at its anterior extremity. The kidney is freed as usual and if there is much perinephritis on its anterior surface there is no objection whatsoever to opening the peritoneal cavity, walling off the intestines, removing a section of the peritoneum adherent to the anterior surface of the tumor, but carefully dissecting the colon free with due respect for its vascular supply.

Performed through a large incision in this manner the operation presents singularly few difficulties. Its one grave complication is tearing of the vena cava. I have twice torn the cava, losing one patient at the end of twenty-four hours by hemorrhage, and saving the other by a lateral clamping. If the wound is below the renal pedicle, as is usually the case, the cava may be ligatured; but as a rule it may be

closed by suture or by lateral clamping. But there is actually no excuse for wounding this vessel. The surgeon should remember that it is often drawn up over the kidney, covering its anterior surface almost up to the point of contact with the colon. With this in mind one may avoid the cava by freeing the colon gently toward the lower pole of the kidney, then identifying the great vessels and following these up over the anterior surface of the tumor. One need scarcely add that this danger only refers to the right kidney.

NEPHRECTOMY FOR NEOPLASM

The principles of this operation differ from those of ordinary nephrectomy in two ways:

1. The perirenal fat must be removed with the kidney unless we are to expect regional recurrences.

2. The veins, not only those of the pedicle, but also those covering the surface of the tumor must be ligated before the tumor itself is much disturbed for fear of venous embolism.

In order to fulfill these two indications a large incision and early ligature of all vessels, including those of the pedicle, are of first importance. If the kidney is not more than twice its normal size it may be very comfortably handled through the transverse incision. But if it fills the loin the T-shaped incision is preferable. The vertical incision along the outer border of the rectus may be made three or four inches in length (Cabot prefers to divide the rectus and make his vertical branch in the median line, thereby sparing the nerves). Through this incision the peritoneum may be boldly entered and the renal pedicle tied off before the kidney is disturbed at all. Then the veins over the surface of the kidney, most of which anastomose with some peritoneal vessels about the lower pole, are taken care of. Then the tumor is removed with due respect for the position of the vena cava.

As an aid to the removal of the kidney, we may note the *resection of the outer portion of the last rib.* This is done just as in the operation for empyema, great care, however, being taken to spare the pleura. I have never resected the rib, and Albarran states that, in several hundred kidney operations, he has only had to do this four or five times.

Accidents During the Operation.—*The peritoneum may be torn* during the operation. This accident is unimportant, even though the kidney be septic. The peritoneal cavity is walled off with pads and the operation continued in the usual manner. At its termination the peritoneum is sutured.

Incision of the pleura is attended to in the manner already described (p. 686).

Tearing of the kidney itself, or of its pelvis, is an unfortunate complication, since it may render septic an operation that would otherwise be clean.

If the ligature slips from the pedicle the immediate hemorrhage is terrifying; but there is no grave danger so long as the surgeon does not become panic-stricken. He should plunge his hand into the wound and grope for the rush of blood as it issues from the vessels. Gentle pressure proximal to this point promptly controls the bleeding. Clots are then mopped out and the wound widely retracted so that the bleeding points can be seen and clamped. Under no circumstances should clamps be used wildly and blindly in the depths of the wound.

Tearing of the vena cava is an extremely grave accident.

Postoperative Complications.—*Hemorrhage* may be controlled by packing.

Insufficiency of the opposite kidney should be foreseen and prevented by Murphy drip and colon irrigations.

One should operate on the third day of *anuria,* even without symptoms, or on the first appearance of twitching during sleep, contortions of the pupil, or headache.

Urinary fistulae sometimes follow the operation, the urine being discharged up the ureter from the bladder. Such discharges ultimately cease. *Purulent fistulae* require secondary operations. These should be performed, if possible, behind the scar of the first operation, in order to spare the peritoneum.

CHAPTER LXXII

OPERATIONS UPON THE URETERS

INCISION OF THE PARIETES

The *abdominal portion* of the ureter may be reached extraperitoneally, either through the usual oblique lumbo-abdominal incision extended well forward, or through a vertical incision at the outer border of the rectus.

The lower pelvic portion of the ureter can be reached by median section.[1] The incision usually employed lies to the outer side of the rectus below the umbilicus. I much prefer Gibson's [2] incision: a demi-Pfannenstiel, extending in a curve from the anterior superior spine to and across the median line just above the pubes. The internal oblique and transversalis muscles are divided vertically at the outer edge of the rectus.

The patient is put in the *Trendelenburg position* either before or immediately after the incision of the parietes.

When *the peritoneum* is reached this is drawn toward the median line and carefully dissected free from the lateral pelvic wall, *carrying the ureter with it.* This duct is identified where *it crosses the brim of the pelvis at the iliac bifurcation* and followed down to its insertion into the bladder.

URETEROTOMY FOR STONE

In the female, large stones caught just external to the bladder may be reached by incision in the vaginal vault; but if the stone is at all movable it is fixed in this position with great difficulty, and when the incision in the vaginal vault has been made the stone will be found to have slipped out of reach up the ureter. For small stones, therefore, even in the female, the abdominal route is preferable.

Stones caught in the intravesical portion of the ureter may be extracted either by intravesical operation (p. 760) or by suprapubic cystotomy (p. 719).

[1] Judd (*Ann. Surg.*, 1914, lix, 393), Squier and Warren (*Trans. Am. Assn. G.-U. Surg.*, 1915) often employ the median incision.

[2] *Trans. Am. Gen. Urin. Assn.*, 1909, vol. iv.

Small stones should be encouraged to pass by injection of the ureter (p. 398).

With these exceptions the stone must be reached through one of the abdominal incisions described above. If there is any possibility that the stone is a movable one, a radiograph should be taken *immediately* before operation.

Most stones for which operation is required are found fixed in the lower ureter at the level of the spine of the ischium, or beyond this. If the stone is movable, it may often be readily milked up into some more accessible portion of the ureter in which a vertical incision is made, after the ureter above this point has been gently compressed by an assistant's fingers or a protective clamp. Before closing the ureter a large-sized probe should be passed down into the bladder to dilate any stricture that may be present.

If the stone cannot be moved by external pressure one may attempt to dislodge it by a Mayo gall-stone scoop introduced through an incision in the ureter higher up. Even this may fail, however, and in that event it is necessary to incise the ureter over the stone. At this point the ureter is likely to be relatively inflamed and there are theoretical objections to incising it; but I have done this several times and seen no harm result. After incision of the ureter one should never forget to pass the probe into the bladder. The incision is then caught together by several intestinal sutures of catgut, a cigarette drain left in the wound, and the parietes closed around this.

The drain may be removed at the end of forty-eight hours. Rubber tubing should never be employed for drainage in the pelvis lest it result in secondary hemorrhage from pressure on the iliac arteries as described by Moschowitz.[1]

Cabot[2] mentions three cases treated without drainage. I have omitted drainage in several of my own cases, but one had a rather stormy convalescence as the result of mild subperitoneal infection.

PLASTIC OPERATIONS

Plastic operations are employed whenever possible for the reëstablishment of the lumen of an obstructed ureter. Previous to operation the functional capacity of the kidney is studied and if this is worth preserving the ureteral obstruction is defined by pyelography.

It will be found that in the great majority of cases the liberation of adhesions, and the straightening out of kinks in the ureter, nephropexy or incision of strictures with postoperative drainage by ureter catheter for at least ten days, will relieve such obstructions as have

[1] *Annals of Surgery*, 1908, xlviii, 872.

[2] *Boston Med. & Surg. Jour.*, 1910, clxiii, 789.

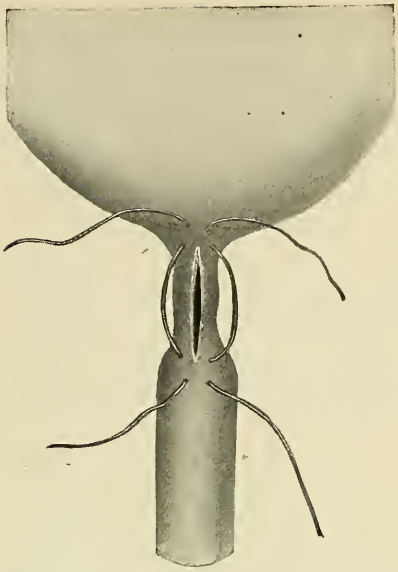


Fig. 154.—Ureteroplasty or Pyeloureterotresis (after Morris). The stricture is incised longitudinally and two sutures are inserted.

not totally destroyed the kidney. Exceptionally, however, a real plastic operation is required to relieve obstructions at the junction of the ureter and kidney pelvis. Eliot [1] has collected, classified and enumerated 111 cases according to the following plan:

1. **Division of Spur.**—(11 cases.) If the ureter is adherent for some distance along the wall of the pelvis the obstruction may be sometimes relieved by incising the spur and suture of the corresponding edges of the incision to each other so as to leave an open orifice.

2. **Ureteropyeloneostomy.**—(18 cases.) The ureter is divided and re-implanted in the lowest portion of the kidney pelvis. Before implantation the tip of the ureter should be split for half a centimeter on each side and the flaps thus produced should be affixed to the inner surface of the kidney pelvis by a single suture each.

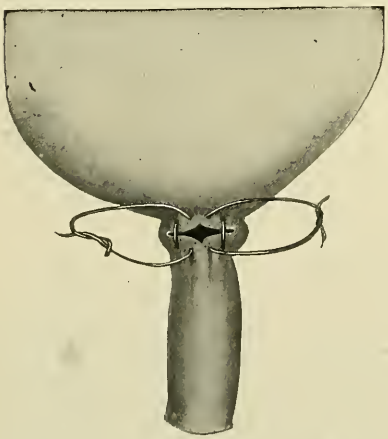


Fig. 155.—Ureteroplasty or Pyeloureterotresis (after Morris). The sutures are drawn so as to make the incision transverse.

Fig. 156.—Ureteroplasty or Pyeloureterotresis (after Morris). The result.

3. **Ureteroplasty.**—(27 cases.) Stricture at the ureteral orifice is incised longitudinally and sutured transversely.

[1] *Jour. d'Urol.*, February 15, 1913, iii, 2.

4. **Lateral Anastomosis.**—(20 cases.) The ureteral canal is opened longitudinally at a point opposite the lowest portion of the kidney pelvis and this incision sutured to a corresponding one in the pelvis.

FIG. 157.—END-IN-END ANASTOMOSIS. (Poggi.)

5. **Pyeloplication.** — (10 cases.) The bulging pelvis is crumpled permanently by a series of nonpenetrating in-and-out sutures.

6. **Resection of the Pelvis.** —(10 cases.) The bulging pelvis is cut away and resected.

Eliot mentions four cases in which the dilated pelvis of a misplaced kidney was anastomosed directly with the bladder and also ten atypical operations.

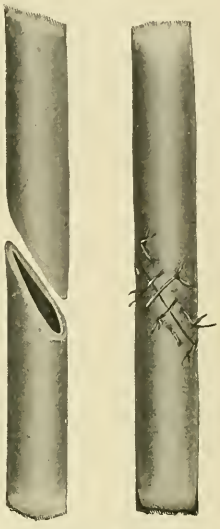
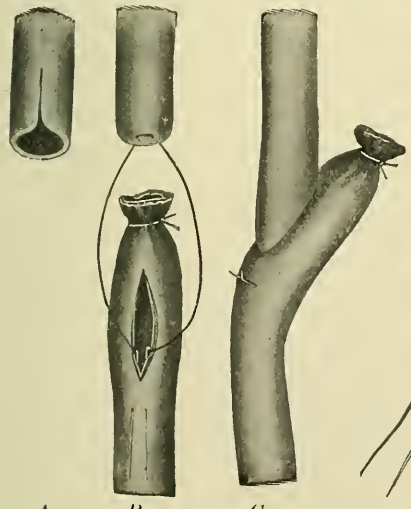


FIG. 158.—OBLIQUE END-TO-END ANASTOMOSIS. (Bovée.)

General Principles.—The following rules will be of service:

1. The drainage obtained by a plastic operation is likely to be much less satisfactory in the performance than in the description. Therefore



A *B* *C*

FIG. 159.—LATERAL ANASTOMOSIS. (Van Hook.)

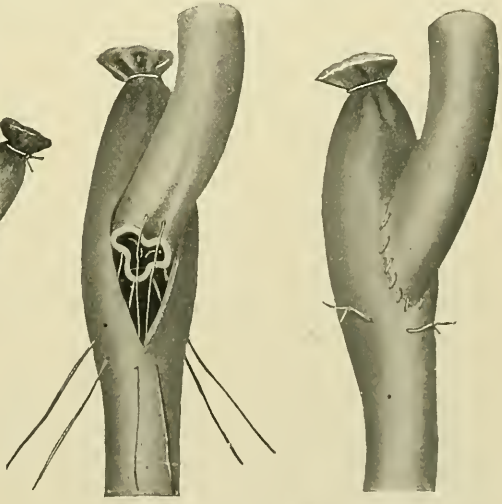


FIG. 160.—LATERAL ANASTOMOSIS. (Bache Emmet.)

every effort should be made to relieve ureteral obstruction by other means without plastic operation.

2. If the sutures are to hold there must be literally absolutely no tension between the ureter and the kidney pelvis.

3. All penetrating sutures must be of plain catgut; nonpenetrating sutures may be of silk or linen.

4. In order to encourage firm union the kidney should be drained through the loin for at least a week and during this time the points of union should be kept open by means of a ureter catheter or a small catheter introduced through the kidney into the orifice of the ureter.

REPAIR OF URETERAL WOUNDS

Direct end-to-end anastomosis predisposes to stricture. In order to avoid this the three following methods have been devised (but unfortunately in most instances so much of the ureter is destroyed that none of them can be employed).

1. End-in-end anastomosis.
2. Oblique end-to-end anastomosis.
3. Lateral anastomosis (end-in-side).

End-in-end Anastomosis.—This operation was first suggested by Poggi, and has been modified by Mayo Robson [1] and Gubaroff.[2] The upper end of the ureter is cut obliquely (to prevent stricture) and the lower end dilated (Poggi) (Fig. 157) or incised longitudinally (Robson). The upper end is then drawn into the lower by a single suture, as in Van Hook's operation, the longitudinal incision sutured, and the union strengthened by a circle of fine silk Lembert sutures around the external line of union.

Oblique End-to-end Anastomosis (Wesley Bovée).—Both ends are cut obliquely, dilated,[3] and sutured with rectangular and simple interrupted sutures, re-enforced by a few Lembert sutures (Fig. 158).

It is convenient in this, as in most of the other plastic operations upon the ureter, to suture the tube after the introduction (from the bladder) of a urethral catheter, or, as Howard Kelly [4] has suggested, a guide introduced through a longitudinal incision in the wall of the duct.

Lateral Anastomosis (Van Hook).—

a. Ligate the lower portion of the tube ⅛ or ¼ inch from the free end. Make with fine sharp-pointed scissors a longitudinal incision twice as long as the diameter of the ureter in the wall of the lower end, ¼ inch below the ligature.

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[1] *Internat. Med. Ann.*, 1896, p. 602.

[2] *Centralbl. f. Chir.*, 1901.

[3] The ureter can be dilated with ease to twice its normal size.

[4] *Jour. of the Am. Med. Assn.*, 1900, xxxv, 860.

b. Make an incision with the scissors in the upper portion of the ureter, beginning at the open end of the duct and carrying it up ¼ inch. This incision insures the patency of the tube (Fig. 159, *A*).

c. Pass two very small cambric needles armed with one thread of sterilized catgut through the wall of the upper end of the ureter ⅛ inch from the extremity, from within outward, the needles being from $\frac{1}{16}$ to ⅛ inch apart, and equidistant from the end of the duct. It will be seen that the loop of catgut between the needles firmly grasps the end of the ureter.

d. These needles are now carried through the slit in the side of the lower end of the ureter into and down the tube for ½ inch, where they are pushed through the wall of the duct side by side (Fig. 159, *B*).

e. It will now be seen that the traction upon this catgut loop passing through the wall of the ureter will draw the upper fragment of the duct into the lower portion. This done, the ends of the loop are tied together securely, and, as the catgut will be absorbed in a few days, calculi do not form to obstruct the passage of urine (Fig. 159, *C*).

f. The ureter is now enveloped carefully with peritoneum. This may be done by lifting the duct gently into the cavity of the peritoneum, drawing down the serous membrane carefully behind the ureter, and after pulling the peritoneum around it, stitching it in a position to permanently inclose and protect the tube.[1]

Bache Emmet employs three sutures to drag the upper segment into the lower one. This for the purpose of puckering the upper segment, if it is considerably dilated (Fig. 160).

We may disregard the discussion of the relative methods of the three procedures, but the following observations seem apposite:

1. Invagination, whether end-in-end or end-in-side, may be performed more easily and rapidly than Bovée's operation.

2. End-in-side anastomosis wastes more of the length of the duct than either of the other two. Bovée claims that his operation may be performed even though as much as 3 inches of the duct have been cut away.[2] He has also suggested that in case of need the kidney may be loosened and stitched low in the loin.

3. Whatever method is employed it is customary to use catgut for all sutures that enter the lumen of the duct, and silk for the others; this in order to avoid calculous incrustation.

4. When the lower end of the ureter is divided or strictured, cysto-ureterotresis is the operation of choice. When this is impracticable, the choice lies between cutaneous fistulization and nephrectomy, with a preference for the latter, if the opposite kidney is able to support life.

Cysto-ureterotresis.—Cysto-ureterotresis (ureterocystoneostomy) is the implantation of the ureter into an incision in the bladder wall. It has been usually employed for the relief of ureterovaginal fistula, and after operative resection of the lower ureter.

[1] Van Hook is here speaking of an intraperitoneal operation, which ureteral anastomosis almost always is.

[2] *Jour. of the Am. Med. Assn.*, 1901, xxxvii, 254.

Poggi, in 1887, made the first experiments in reference to this operation. Novaro and Bazy were the first to perform it.

Three routes have been chosen—viz., vaginal, sacral, and abdominal. The vaginal and sacral routes have nothing to recommend them.

Almost every surgeon who has performed the abdominal operation has devised his own technic. The various methods have been enumerated by Boari [1] and Morris.[2] To avoid confusion, it is best to describe only a type operation. The peculiarities of each case will suggest the necessary modifications.

Whether the ureter is to be attached intraperitoneally or extraperitoneally is decided by the features of the case. It is safer to operate extraperitoneally through the lumbo-inguinal incision when possible, elevating the peritoneum until the bladder (distended with boric acid solution) is entirely exposed, freeing the ureter from the peritoneum and drawing it down.

The bladder is then emptied by catheter and incised on the point of a sound at the most convenient point. The ureteral orifice is then split to prevent stenosis, and attached to the bladder by means of a catgut traction suture (as in the Van Hook anastomosis). It is convenient at this juncture to introduce a ureteral catheter and upon it to suture the outer layers of ureter and bladder. When the operation is performed within the peritoneum the line of union should be protected by a peritoneal or an omental fold.

After operation it is customary to leave the ureteral catheter in place for a week.

The success of the operation depends upon the absence of any tension whatever between the ureter and the bladder. But even so, renal infection results in the great majority of cases. This may subside or may require nephrectomy.

In several instances the ureter has seemed too short. An inch or more may be gained by loosening the pubic attachments of the bladder (Witzel, Kelly, Penrose) and suturing its fundus to the lateral pelvic wall.

OPERATIONS TO DIVERT THE URINARY STREAM

Nephrostomy.—The operation has been described on page 691. If the nephrostomy is to be permanent the ureter must be ligated with silk. Cups have been devised by Watson of Boston, Loux of Philadelphia, and others to catch the urine from a loin fistula.

Ureterostomy.—Implantation of the ureter into the loin may be

[1] *Guyon's Annales,* 1899, xvii, 1059, 1141.

[2] *Op. cit.,* ii, 563.

done much more readily than nephrostomy, for it is no easy matter to open the normal kidney pelvis and drain the organ in such a way that it will remain fistulous; whereas through a rather high Pfannenstiel incision, with division of the deeper muscles at the outer border of the rectus on each side, each ureter may be picked up where it crosses the brim of the pelvis at the bifurcation of the iliac vessels, freed well down into the pelvis and up into the loin, and brought out at a convenient spot in the side without difficulty. The best point for implantation may be found at the center of an imaginary circle made by placing a goblet on the side at a point where its edge will neither touch the ribs nor the crest of the ilium. The skin and muscles are punctured at this point and a long pair of forceps driven through into the subperitoneal space. With this the divided end of the ureter is caught and brought out of the side. The ureter must be freed sufficiently to permit at least an inch of it to hang free outside of the skin without tension and without kinking within. The ureter is caught in place by two light catgut sutures, and a ureter catheter introduced to the kidney pelvis in order to minimize the retention and the acute renal infection which inevitably follow ureteral transplantation.

Both ureterostomy and nephrostomy are filthy procedures liable to stoppage of the fistulous tract and consequent acute renal infection or retention with fatal results. The most satisfactory cases in this regard have been those of pyonephrosis with kidney pelves so distended that they could be readily and largely anastomosed to the loin.

Ureteral Anastomosis with the Intestine.—Some of the innumerable methods devised for implanting ureters into the intestines are described and discussed by Zesas.[1] The following rules may be laid down:

1. The implantation must be made entirely without tension.

2. The exclusion of a loop of intestine to form an artificial bladder has proven almost universally unsuccessful.

3. The ureter must be implanted obliquely.

4. The cause of failure is either leakage at the point of union or ascending infection of the kidney. This almost inevitably occurs just as it does after ureteral implantation into the skin, but with this difference, that it is impossible to provide adequate drainage with the ureter mouth lost in the bowel. The vast majority of operations have proven fatal. Statistics collected from the few successful cases bear no relation to the actual facts. Coffey[2] states that Mayo has successfully implanted both ureters of twelve patients by the following method:[3]

[1] *Deutsche Zeitschr. f. Chir.*, 1909, ci, 3.
[2] *Jour. A. M. A.*, 1915, lxv, 1246.
[3] *Ibid.*, 1911, lvi, 397.

First, the duct is located and ligated with linen or silk. It is then cut in two above the ligature and the edges caught and held with mosquito forceps while one wall of the duct is split down with a pair of scissors. A linen suture is now passed through the split end of the duct so as to include about one-half of it, and tied. The linen thread is then thrown around the other half and tied. The loose ends are then threaded into two needles. By this method the full strength of the duct is retained for traction, while the opening is maintained by the split. The end of the duct is now wrapped with gauze while the intestine is prepared for its reception, which is done as follows:

The part of the intestine desired is picked up and an incision made down through the peritoneal and muscular coats, including submucous tissue until the mucous membrane pouts out through the incision (Fig. 161). This incision should be about one inch long or more. Second, five or six sutures are passed

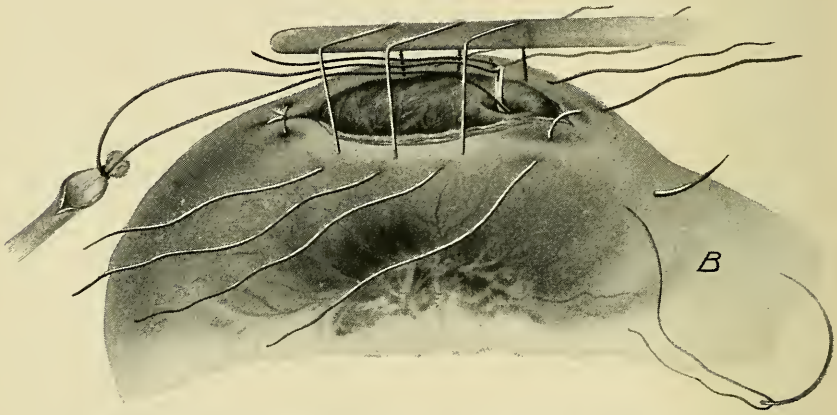

Fig. 161.—Uretero-intestinal Anastomosis. (Coffey.)

which pick up the peritoneal and muscular coats on each side of the incision. The suture at the upper end of the incision is tied as a control suture. The intermediate intestinal sutures are lifted up on the flat handle of an instrument as they cross the incision. Now the intestine is brought down close to the end of the split duct and the two needles carrying the threads (traction sutures) on the end of the duct are passed beneath the four or five intestinal sutures and through the stab wound in the mucous membrane into the intestinal lumen and out through the intestinal wall three-quarters of an inch farther along the intestine, and one-eighth to one-quarter inch apart. By making tension on these threads and at the same time pushing the intestine toward the duct, the duct is drawn beneath the intestinal sutures through the stab wound into the intestinal lumen, when the two ends of the threads on the duct are tied on the outside, thus anchoring the end of the duct on the inside of the intestine at this point (Fig. 161). The intestinal sutures are then tied. After this operation the duct lies just beneath the mucous membrane, which has been loosened for approximately three-quarters of an inch of its course, so that it slides easily in its new channel. It is therefore necessary to tack the ureter to the peritoneum of the intestine near its point of entrance by two or three fine linen or silk sutures. Care should be used to take only the outer coat of the ureter in the bite of these sutures.

Maydl's Operation.—In 1894 Maydl[1] reported his first cases of ureterotrigonal anastomosis. This operation consists of the implantation into the colon, not of the ureter itself, but of the bladder wall surrounding the mouth of the ureter. The operation has usually been employed for exstrophy of the bladder, and is performed as follows: A ureteral catheter is introduced into each ureter and an elliptical section surrounding the mouths of both ureters is then cut from the bladder wall, great care being taken not to injure the ureters. Next, the peritoneal cavity is opened. A convenient loop of the sigmoid flexure or the rectum is selected and brought out of the abdominal wound. The ureters, with their attached portion of trigone, are then freed, a longitudinal incision is made in the wall of the gut, with the necessary precautions, and into this the section of trigone is sutured. The remainder of the bladder is now stripped of its mucous membrane and the abdominal wound closed as tightly as possible, with splitting and transposition of the recti, if necessary. As a final precaution the sphincter ani is stretched and a tube inserted and left in for several days to establish drainage and to minimize the danger of leakage and renal retention.

The immediate mortality from shock and infection is at least 25 per cent. Yet the operation continues to enjoy a popularity founded upon the hope that springs eternal in the ambitious surgeon's breast.

Peters's Operation.[2]—This modification of Maydl's procedure consists in dissecting out each ureter separately with its surrounding bit of trigone, and implanting each in a separate hole punctured in the anterior rectal wall immediately behind the wound made by freeing the ureters, the whole operation being extraperitoneal. The ureter ends hang free in the rectum. The ureter catheters are immediately withdrawn and the sphincter stretched to prevent back pressure. This is the simplest and safest of all the operations devised for the cure of exstrophy. It should be performed on patients between the ages of 5 and 15.

[1] *Wien. med. Wochenschr.*, 1894, xliv, 1113, 1169, 1209, 1256, 1297. *Ibid.*, 1896, xlvi, 1241, 1333, 1373. *Ibid.*, 1899, xliv, 249, 304, 360. Cf. also Frank, *Deutsche Zeitschr. f. Chir.*, 1912, cxiii, 427; Oppel, *Urol. and Cutan. Review*, 1913, I, 1; and Mayo, *Ann. Surg.*, 1913, lviii, 133.

[2] *Brit. Med. Jour.*, 1901, June 22.

CHAPTER LXXIII

ANATOMY OF THE BLADDER—SUPRAPUBIC OPERATIONS

ANATOMY

The bladder is a muscular sac lying, in the male, between the rectum and the pubes when empty, and distending, when full, into an oval bag occupying more or less of the hypogastrium (Fig. 17). Its position is fixed below by the urethra, by the pelvic fascia (as puboprostatic and inferior vesical ligaments), and by the rectovesical fascia, which binds the prostate and the neck of the bladder to the rectum. The muscular tissue of the organ is covered on the outside by peritoneum, on the inside by mucous membrane.

Above and on the sides the peritoneum covers the bladder. When the bladder is empty it lies contracted behind the pubes; the peritoneum leaves the abdominal walls at the symphysis and passes at once to the bladder, over which it is spread, and thence reflected upon the rectum from the base of the bladder, so that when the latter is absolutely or even partially empty no trocar or aspirating needle may reach it from the anterior abdominal wall without traversing the peritoneal cavity.

Very different, however, is the condition of the viscus when distended. Then, as its cavity fills up, the peritoneum is carried with it. In this way the distended bladder carries up the peritoneum in front, so that in extreme retention a distance of 2 to 5 cm. above the symphysis becomes bare of peritoneum. Hence the election of the region *immediately* above the pubes for aspiration of the bladder.

The relation of the peritoneum to the bladder also varies behind. When the viscus is distended the peritoneum barely reaches the blind ends of the seminal vesicles; when empty it descends between them almost to the prostate.

The *shape* of the bladder varies with age. The bladder of an infant is ovoidal in shape, with its long axis running downward and a little forward, and its apex at the urethral orifice. It lies, when full, almost entirely out of the pelvis. As age advances the bladder sinks into the pelvis, assumes an almost spherical shape when filled and possesses a flattened floor in the region of the trigone.

The *muscle* of the bladder is composed of three coats—external, middle, and internal. The external or longitudinal coat consists of

numerous fibers running from the prostate up over the fundus, where they are met by a similar set of fibers from the anterior surface. At the place of meeting there is a swirl or "cowlick" of muscle fibers. Over the sides of the organ the longitudinal layer is thin and unimportant. Its fibers are closely connected with the prostate and the deep layer of the rectovesical fascia, and intermingle with the deeper layers of the bladder muscle. The middle layer forms the bulk of the vesical muscle. Its fibers are densely interlaced and have a generally circular character. The internal layer of muscle consists of a few scattering bundles of longitudinal fibers, so irregular and inconspicuous that some anatomists deny their existence.

The *trigone* of the bladder is part of the urethra (p. 37).

The *mucous membrane* of the bladder is of a pale salmon color, remarkably insensitive in health, except at the ureter orifices, covered by a stratified pavement epithelium, and lies in folds when the bladder is contracted, except over the trigone, where it is always smooth. The glands are few and occur almost exclusively on the trigone. They are exceedingly small. A little lymphoid tissue is usually found irregularly distributed in the mucosa. The coats of the bladder are united by connective tissue, which is everywhere loose, except at the trigone.

The bladder is arbitrarily described as being composed of a *vault,* two lateral walls, a *fundus* (the pouch behind and above the trigone), and a *trigone.* The urethral orifice is often spoken of as the bladder *neck.* The ureters pierce the floor of the bladder obliquely and open at the lateral angles of the trigone.

The *arteries* of the bladder are the superior, middle, and inferior vesical. They anastomose freely. The *veins* are numerous and lie in three planes—the subserous, the intermuscular, and the submucous. They anastomose freely with one another and with the prostatic plexus, and the plexus of Santorini above the neck of the bladder. They empty into the hypogastric veins. The *lymphatics* of the bladder wall were overlooked by the older anatomists, but their existence has been repeatedly verified of late years. They run chiefly beneath the mucous membrane and empty into several small groups of glands lying about the bladder itself and thence into the iliac glands along the internal and common iliac vessels. These iliac glands are commonly infected by vesical neoplasms. The lumbar glands are less frequently involved, the inguinal glands very rarely (Pasteau[1]) The *nerves* are derived from the third and fourth sacral by way of the hypogastric plexus.

The fetal bladder is connected with the allantois by the *urachus,* and this canal, closing at the time of birth, persists as a fibrous, subperitoneal cord connecting the fundus of the bladder with the umbilicus.

[1] "État du système lymphatique dans les maladies de la vessie et de la prostate," Paris, 1898, p. 48.

This canal very exceptionally remains patent throughout the whole or a part of its length.

ANESTHESIA FOR BLADDER OPERATIONS

Local anesthesia is gaining in favor for suprapubic section. Puncture and aspiration of the bladder may be done without any anesthesia at all, or with only a drop of cocain in the skin. Suprapubic cystostomy may be done under the familiar infiltration anesthesia; one has only to remember that the bladder itself is sensitive and requires infiltration as well as the parietes.

But if any work is to be done inside the bladder, even though this amount to so little as the removal of a stone, this viscus should be filled, before the infiltration of the parietes is begun, with 2 ounces (75 c.c.) of 1 per cent novocain solution. Injection of cocain solution into the normal bladder would probably do no harm, but one never operates upon a normal bladder and the inflamed mucosa may absorb the drug. After this injection the abdominal wall is infiltrated and opened layer by layer as described below. When the bladder is reached the novocain solution is drawn off through the catheter and the bladder filled with boric acid solution to the point of distention. It is then incised and the stones removed.

I have not been successful with local anesthesia for more extensive operations upon the bladder. The prostate can sometimes be removed under local anesthesia; the best way to obtain this is to inject the anesthetic into the vesical surface of the prostate. On the whole I prefer the anesthesia described in the section on prostatectomy.

SUPRAPUBIC OPERATIONS UPON THE BLADDER

The following are the types of operations performed upon the bladder by the suprapubic route:

Puncture and aspiration of the bladder.
Suprapubic cystotomy and cystostomy.
Suprapubic lithotomy.
Suprapubic section for tumor.
    Removal of pedunculated growths.
    Partial cystectomy.
Intraperitoneal cystotomy.
    Ureteral implantation.
    Complete cystectomy.
Excision of diverticulum.
Suprapubic prostatectomy.

PUNCTURE OF THE BLADDER

In pre-antiseptic days *puncture of the distended bladder* gave such bad results that it was abandoned in favor of aspiration. Puncture may, however, be employed with safety if a few simple precautions are taken.

Indications.—Puncture of the bladder is called for whenever continuous drainage is required which cannot be obtained by urethral catheter.

Special Instruments Required.—Trocar and cannula of such size that a 15 French soft-rubber catheter will pass snugly through the cannula. The catheter should have two eyes and should be of soft rubber.

Technic.—The hypogastrium is shaved and prepared as for a major operation. Before beginning the operation, the surgeon assures himself by percussion and palpation that the bladder underlies the abdominal wall, and that no intestines intervene. The skin is then infiltrated with 0.5 per cent cocain solution in the median line for a distance of 2 cm., beginning *immediately* above the pubes. The infiltrated skin is incised and drawn apart by two artery clamps. The subcutaneous tissue and the fascia of the linea alba are then infiltrated and incised. The trocar and cannula are then introduced through the incision and plunged into the bladder, the trocar withdrawn and the soft-rubber catheter *immediately* introduced through the cannula into the bladder before the urine has flowed out and the cannula withdrawn.

The catheter should project at least 3 cm. into the cavity of the bladder.

It is then caught to the skin by a suture and a rubber tissue drain introduced alongside it down to the bladder wall.

After-treatment.—The drain is withdrawn in forty-eight hours, the wound protected by antiseptic dressings until it heals, the bladder irrigated through the catheter every day, and the catheter attached to an appropriate receptacle to catch the urine. The patient need not be confined to bed after operation. The catheter is changed every 5 days.

Complications.—If the proper technic is precisely followed puncture of the bladder is perfectly safe, but carelessness in asepsis or in technic is severely penalized by pelvic cellulitis due to infection or peritonitis due to puncture of the peritoneum.

Infection of the peritoneum will be avoided if the bladder is really distended up under the belly wall when the puncture is made, and the trocar is driven into the bladder just as close to the upper border of the pubes as possible, and the catheter introduced immediately, before the bladder can empty itself.

ASPIRATION OF THE BLADDER

The hypogastrium is prepared antiseptically and the bladder percussed as for puncture. An aspirating needle 4 cm. long should be used. This is plunged directly into the bladder at a point about 1 cm. above the pubes. The urine is aspirated and suction continued as the needle is withdrawn.

The danger of infection along the track of the needle is slight.

Aspiration is preferable to puncture only when the relief of retention is required but for a few hours. For more prolonged drainage a single puncture is preferable to repeated aspirations.

SUPRAPUBIC CYSTOTOMY

Entrance to the bladder may be gained by the perineal route or by direct opening of the bladder through a suprapubic incision. The latter operation was considered by the older surgeons to have the higher mortality. But asepsis during the operation and care in the management of the drainage thereafter has rendered the mortality negligible.

Anesthesia.—Suprapubic drainage can be done under local anesthesia.

Preparation of the Patient.—The patient is shaved and cleaned as for a major operation, hexamethylenamin is given in 1 gram doses for one or two days preceding operation, and the bladder is prepared either by continuous catheterization or by daily irrigation with silver nitrate solution in strength of from 1 in 3 to 1 in 5,000.

The Incision.—An incision is made in the linea alba at least 6 centimeters in length beginning just above the pubes. In separating the recti the pyramidales are cut through. The recti are then retracted, revealing the transversalis fascia. This is drawn upward to make it tense, and divided transversely close to the upper border of the symphysis (Fig. 162). Then the fascia and subjacent fat are rolled upward away from the bladder. In this layer of fat is the peritoneum which is not seen unless it is accidentally torn.

As the bladder comes into view it is recognized by the parallel vertical muscle fibers. It is still further identified by the large veins running in the same direction as the muscle fibers. As the fat is rolled away from the bladder it will be noted that it adheres to this organ in the median line. This is due to the presence of the urachus. This adhesion may usually form the limit of our denudation, but if an extensive exposure of the bladder is required the urachus may be divided and tied (for it usually contains an artery).

Distention of the Bladder.—It is not my practice to distend the bladder at all unless there is some difficulty in locating it, for the pour-

ing out of fluid from the incision in the bladder is a minor inconvenience and delay in the operation. It is customary, however, to distend the bladder either with sterile water or else with air. Inasmuch as rupture of the bladder has several times resulted from distention of this organ before it was incised, and inasmuch as the slowly rising globe of bladder as the water fills it adds precision to the surgeon's knowledge

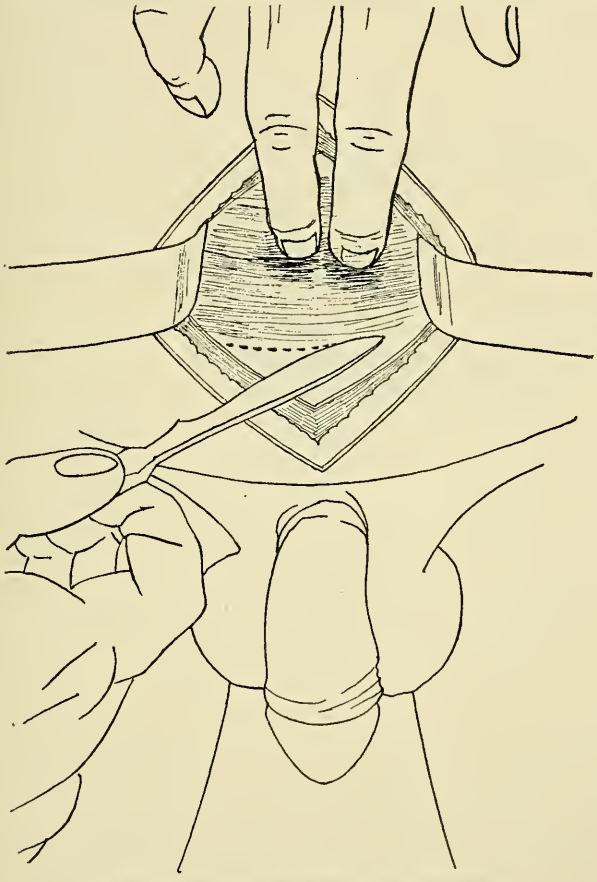

FIG. 162.—EXPOSURE OF THE BLADDER.

of the position of the viscus, it is better that it should be distended only after the parietes have been divided.

Distention with air introduced by means of the pump of a Paquelin cautery was much in favor a few years ago. Over-distention and rupture are doubtless less likely to occur when air is employed than with fluid. Nicolich and Marion [1] have both reported deaths occurring as the air was being injected into the bladder and before the operation had begun. The air was found in the great vessels and in the heart.

[1] *Jour. d'Urol.*, 1913, iii, 44.

Incision of the Bladder.—As soon as the bladder muscle is recognized and well exposed this organ is caught on each side of the median line by a skin hook (or by a suture introduced with a curved needle). With the bladder wall thus distended on each side a vertical median incision about 3 centimeters long is made in it. If the bladder has not

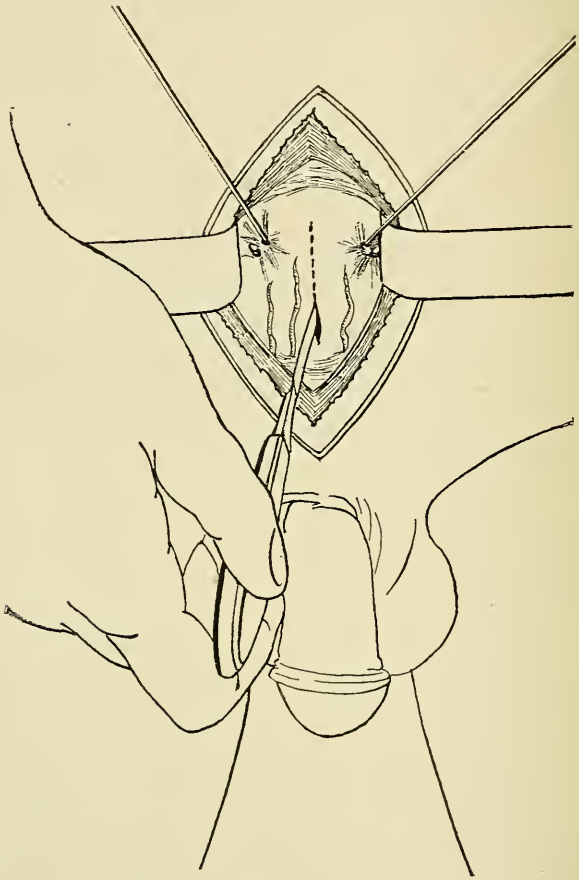

Fig. 163.—Incision of the Bladder.

been distended one must exercise a little care to get well through the mucous membrane. If it has been distended one must await the outflow of fluid. Great care should be exercised not to incise the bladder too far upward toward the umbilicus for fear of opening the peritoneum and bladder at the same time. Opening the peritoneum before the bladder is a matter of no consequence; opening both together is dangerous.

As soon as the mucosa of the bladder is identified this is seized on each side by Kocher clamps and the operation, whatever it may be,

proceeded with while the skin hooks are disengaged from the bladder muscle.

Suture of the Bladder.—The bladder may be closed with or without drainage. If there is no retention and no great hemorrhage within the organ it is safe to suture without drainage even though there be considerable infection. A very satisfactory suture is that of Lower.[1] This is practically a subcuticular suture in the bladder muscle just beneath the mucosa. When this has been placed from end to end of the incision one returns with an over-and-over suture penetrating all the layers except the mucosa.

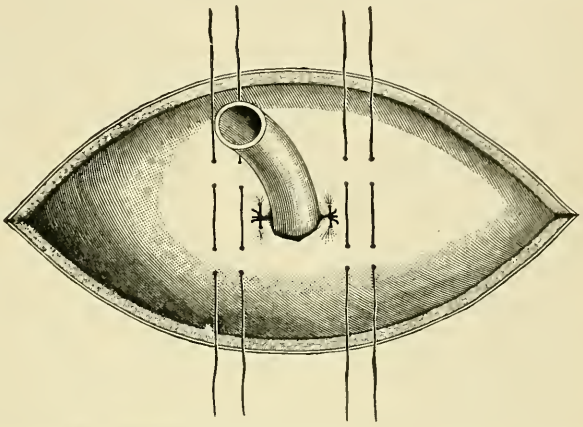

Fig. 164.—Inversion of Bladder Wall About Tube. (Gibson's Method.)

The suture should be of the finest chromic catgut. Plain catgut does not hold quite long enough and linen or silk will result in permanent fistula with incrustation of the suture even though it does not penetrate the mucosa.

If drainage is to be employed the bladder may be inverted about the tube by Gibson's method as shown in the accompanying illustration (Fig. 164).

When suprapubic drainage is employed the size of the tube should be regulated in accordance with the thickness of the fluid that is to issue from it. Thus after prostatectomy an enormous Freyer tube should be used in order to take care of the blood clots readily. The tube should always be left in the upper end of the bladder wound and the lower end sutured.

The indwelling catheter may often be employed with advantage to provide urethral drainage whether a tube is left in the suprapubic wound or not.

Suture of the Parietes.—After the bladder wound has been sutured the vault of the bladder should be attached to the rectus muscles by a plain catgut suture in order to prevent hernia through bulging of the peritoneum between the bladder and the muscles. The muscles, the anterior sheath of the rectus, and the skin are then closed, leaving space for a cigarette drain to go to the line of suture in the bladder

[1] *Cleveland Med. Jour.*, 1910, ix, 706.

(below the tube if one is employed) in order to drain the space of Retzius. Under no circumstances should the muscles be closed throughout: drainage is always required.

Complications During the Operation.—Opening of the peritoneum before the bladder is opened is remedied by suture. Indeed, if the peritoneum is adherent one may deliberately open it high up in the abdominal wound, put one's finger into the pouch of peritoneum, and thus much more readily separate this from the bladder; after which the wound in the peritoneum is sutured and the bladder opened. If peritoneum and bladder are opened simultaneously the former must be thoroughly dried before it is sutured.

Hemorrhage from the vessels of the bladder wall may prove inconvenient but can readily be controlled.

Postoperative Treatment.—Hexamethylenamin is administered in 1 gram doses, beginning as soon as possible after operation. Murphy drip is employed to encourage kidney action. The cigarette drain is removed in twenty-four hours if tube drainage has been used, forty-eight hours if the bladder has been sewed tight. In order to hasten the healing of the wound the tube should be removed in twenty-four hours or as soon thereafter as the bleeding stops and replaced by a smaller one attached to a suction apparatus. If continuous suction is obtainable this is usually a rather forceful proceeding and in order to spare the tissues of the wound the drainage tube must be surrounded by a loosely fitting outside tube of rubber, perforated with several holes. Otherwise the tissues of the patient are made sore by being sucked into the holes of the actual drainage tube.[1] Where continuous suction is not to be had an admirable apparatus is that of Davis [2] which consists essentially of a very large bottle, rubber-stoppered, with two tubes let through the stopper. One of these is used for aspiration; through it the bottle is attached to a Sprengel air-pump and the air sucked out until the tube collapses. The other tube is then attached to a second bottle, smaller, rubber-stoppered, and also with two outlet tubes. Between the two bottles a capillary tube of great fineness permits the air to escape from the smaller into the larger bottle only by imperceptible degrees, so that the aspiration of the larger bottle will suffice to keep continuous suction going in the smaller one for twenty-four hours or more. The second tube in the smaller bottle is led into the suprapubic wound.

The advantage of this continuous suction is twofold: In the first place, it expedites healing; in the second place, it keeps the patient clean while healing is going on. There is no soiling of dressings and bed, no irritation of the skin, no sloughing of the wound. If a very

[1] Cf. Kenyon, *Surg., Gyn. & Obstet.*, July, 1913, p. 115.

[2] *Jour. A. M. A.*, May 27, 1916.

large tube is used at first the caliber of the succeeding tubes is diminished from time to time as rapidly as the wound appears to heal. The only other attention it will need is the cutting down of granulations.

Finally when the wound is too small for an ordinary catheter to lie loosely in it the suction may be advantageously replaced by an indwelling urethral catheter.

Postoperative Complications.—One should be very careful about employing continuous irrigation through the suprapubic tube. Many cases of postoperative pelvic abscess are due to the irrigating fluid being forced out through the bladder, failing to escape between the muscles, and so forcing its way into the cellular tissue beneath the belly wall.

A much more common and a very annoying postoperative complication is staphylococcus infection of the wound. The wound becomes covered with slough; all the adjacent properitoneal fat and the edges of the anterior sheath of the rectus slough away and the leathery slough covers all the wound. This infection does not occur if continuous suction is employed. When it does happen, however, it may be checked if a tube can be fitted so well to the wound as to keep the urine from it. This can usually not be done, but some help may be expected from the use of the indwelling urethral catheter. Saturated solution of argyrol makes the most efficient bactericide for application to the wound, while the bladder should be irrigated at least twice a day with as strong a solution of argyrol as the patient can bear.

Persistent suprapubic fistula depends essentially upon urethral obstruction. If the urethra is free the belly wound will close. Fistula is encouraged, however, by loss of tissue in the abdominal wall (due to inflammation or repeated operation), and also by malposition of the wound in the bladder. If the tube is sutured into the bladder near its neck this encourages a permanent fistula. One may encourage the healing of the fistula by keeping it clear from slough, cutting down granulations, and the application of the indwelling catheter in the urethra.

SUPRAPUBIC LITHOTOMY

Most stones may be quite readily removed through a suprapubic incision by means of the familiar sponge holder. Large stones, however, require the lithotomy forceps; an instrument whose blades resemble those of the obstetrical forceps and serve the same purpose.

The incision in the bladder wall should be made as small as possible so that it may be sutured tight after the operation. If the stones are to be removed under a local anesthetic one must not forget to anesthetize the interior of the bladder as well as its wall and the parietes.

SUPRAPUBIC SECTION FOR TUMOR

The Incision.—The Trendelenburg position should be employed and the parietes opened by the usual vertical incision which in this instance should extend as high as the umbilicus. Before the bladder is opened its wall is freed much more extensively than usual by division of the urachus and separation of the peritoneum above this (unless these tissues are involved in the growth). If the bladder has been distended with fluid this is now permitted to escape through the urethral catheter in order to soil the wound as little as possible with pieces of detached tumor. The bladder wall is freed quite widely so that it can practically be brought outside the abdomen and incised at a point where a previous cystoscopy has shown that there is doubtless no tumor. Previous to the incision the surrounding tissues are walled off by gauze. The interior of the bladder is then very gently retracted and the surgeon decides whether he intends to continue his operation intra- or extraperitoneally. If intraperitoneally, great care is taken to dry the bladder of its contained urine or irrigation fluid before opening the peritoneal cavity. Then the peritoneum is boldly opened in the median line, the intestines walled off and the bladder attacked. Fortunately (as was first noted by Bovée) the Trendelenburg position practically inhibits the excretion of urine from the ureters into the bladder so that little soiling may be anticipated from this cause.

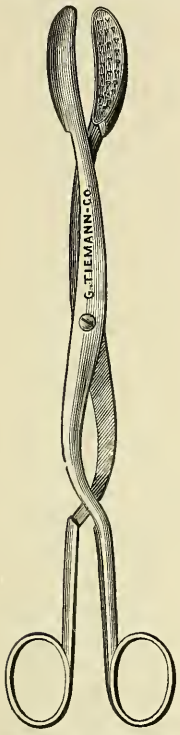

Fig. 165.—Lithotomy Forceps.

Squier [1] suggested the following ingenious way of identifying the various structures about the bladder:

The patient is placed in extreme Trendelenburg position, the anterior abdominal wall incised from the symphysis to a point one inch above and to the left side of the umbilicus. The peritoneum may be opened or the whole operation may be performed extraperitoneally as follows:

The urachus is grasped with a Barret intestinal forceps and traction is made upward, throwing into relief the obliterated hypogastric arteries as they divaricate to enter the true pelvis. The left obliterated hypogastric artery is grasped with forceps and traction made upward and to the right. By blunt dissection between the hypogastric artery and the lateral wall of the pelvis, the vas deferens is brought into view as it courses along the pelvic wall to the inner side of the obliterated hypogastric artery.

With a blunt hook passed along the vas, the pelvic ureter is uncovered, the ureter being crossed on its inner side by the vas deferens. Any radical technique

[1] *Surg., Gyn. & Obstet.*, July, 1914, 91.

directed to the extirpation of neoplasm must have as its essential point the two ureters exposed and constantly in view.

Divide the urachus close to the summit of the bladder and draw the bladder downward toward the symphysis. If the peritoneum is not already infiltrated, divide freely including the pouch of Douglas, mobilizing the entire bladder except the pubovesical attachment. *If* the peritoneum is found firmly attached and already the seat of malignant attachment, this area is left undisturbed and a wide encircling incision is made about the infiltrated peritoneum.

The divided lamella of peritoneum is carefully attached to the upper end of the abdominal incision, so that for further operative purposes the peritoneal cavity is closed.

A one-inch incision is made in the bladder high up in the posterior surface for inspection of the viscus.

The neoplasm is excised *en masse,* together with a wide margin of healthy uninvaded tissue comprising the entire thickness of the bladder wall. If the ureter is affected it is divided above the growth, and the distal portion is removed with the tumor.

The hiatus of the bladder wall is partially repaired with a Connell intestinal suture; a stab-wound is made through the bladder wall at a point approximating the normal ureteral opening, and the proximal end of the divided ureter drawn through this opening by a thin dressing forceps.

The ureter is anchored to the bladder wall, allowing one-half inch to protrude, two flaps being dissected and anchored on the inner surface of the bladder. The remainder of the bladder is closed, and through a stab-wound high on the anterior surface of the viscera a No. 26 F. soft-rubber catheter is inserted and sutured *in situ.*

The final step is the reposition of the peritoneum over the vesical suture line and an accurate closure of the peritoneum, care being exercised not to approximate the peritoneal and bladder suture lines. A cigarette drain is inserted into the back lateral space. In addition, a self-retention catheter is inserted.

Small tumors confined to the vault of the bladder may be excised with a goodly section of surrounding normal bladder wall by a simpler technic. Hagner suggests that the first incision be guided by a cystoscope within the bladder so that the neoplasm itself shall not be incised. A cystoscopy before the operation will, however, often place the tumor accurately enough so that it can be avoided without this complication.

Beer removes all tumors by the actual cautery. For multiple papillomata he employs thorough surface cauterization through a suprapubic opening. For infiltrating growths he first destroys the growth with the actual cautery, then excises its base widely, still using the cautery.

Tumors involving the trigone, and requiring resection of this, call for reimplantation of the ureter in the most convenient portion of the remaining bladder wall.

Practically all of the bladder may be excised excepting the trigone with the expectation that the remaining portion of the organ will dilate sufficiently to retain several ounces of urine.

Extensive growths are, however, not susceptible to cure. The best

we can hope for is a local removal which shall comfort the patient and prolong life. He will die of metastasis.

The statistics of suprapubic removal of tumors are relatively untrustworthy in the sense that no two operators consider precisely the same type of tumors amenable to intravesical removal. Those who report the best results from suprapubic section are usually the ones most reticent in the use of intravesical treatment.

The after-treatment and complications following resection of the bladder, whether intra- or extraperitoneal, do not differ materially from those of simple cystotomy with the exception of the greater shock, the liability to renal infection from transplantation of the ureter, and the increased possibility of peritonitis.

TOTAL CYSTECTOMY

Total cystectomy for tumor should be performed only after preceding disposal of the ureters in the skin or in the intestines. After the patient has recovered from this operation the bladder is removed by an operation consisting of two major steps. In the first the patient is put in the extreme lithotomy position, and the operation begun as though for removal of the cancerous prostate (page 749). The membranous urethra is divided and the prostate freed up to the neck of the bladder. This is not incised, however, but the perineal wound is packed, the patient let down into the Trendelenburg position, for the second stage of the operation. This consists in freeing the bladder from its surrounding attachments through a long vertical intraperitoneal incision. No great difficulty is experienced until the base of the bladder is reached. Here the oozing may be considerable between the seminal vesicles and the rectum; but with a sufficiently large incision this is easily controlled. Effort is made to spare enough of the peritoneum so that the anterior and posterior flaps may be brought together at the close of the operation. Enlarged glands should be excised along the course of the internal iliac artery.

The operative mortality of total cystectomy is very high, and the ultimate mortality still higher. For a growth that is so large as to require total cystectomy almost inevitably has led to glandular metastases which defy eradication. We have not as yet sufficient evidence at hand to decide the value of an extended search for enlarged lymphatics in the pelvis and along the iliac vessels.

SUPRAPUBIC CYSTOSTOMY

Permanent suprapubic drainage of the bladder is performed by median suprapubic cystotomy, followed by suture of the wound in the bladder to the wound in the skin.

Postoperative Treatment.—The drainage-tube is retained in place until the wound has healed. It is then removed and the patient protected by a hypogastric urinal or tube (Fig. 166).

EXCISION OF DIVERTICULUM

The excision of small and relatively uninflamed diverticula is not a very difficult matter, but the larger and more chronically inflamed sacs become so adherent to the lateral and posterior pelvic walls and to the rectum that their total excision is extremely tedious and trying, both to the surgeon and to the patient.

Before operation the general outlines of the diverticula should be studied by cystography.

Squier's technic for resection of the bladder (p. 720) may be advantageously followed as it usually discloses the position of the ureters quite accurately. But if the ureter is hidden by a large diverticulum it is usually better to seek it extraperitoneally at the point where it crosses the iliac bifurcation and to follow it down toward the bladder. It is essential that the relation of the ureter to the diverticulum be thus recognized before excision of the sac is attempted. Having thus identified the ureters and widely freed the bladder the latter is opened in the median line and the diverticulum stuffed full of gauze. Its upper portions are then rapidly freed from the surrounding cellular tissue, its deeper portions more carefully dissected away. The orifice of the diverticulum into the bladder is then excised and the hole thus made in the bladder wound sutured in two rows with chromic catgut not penetrating the mucous membrane. The bladder and abdominal walls are then closed as above described.

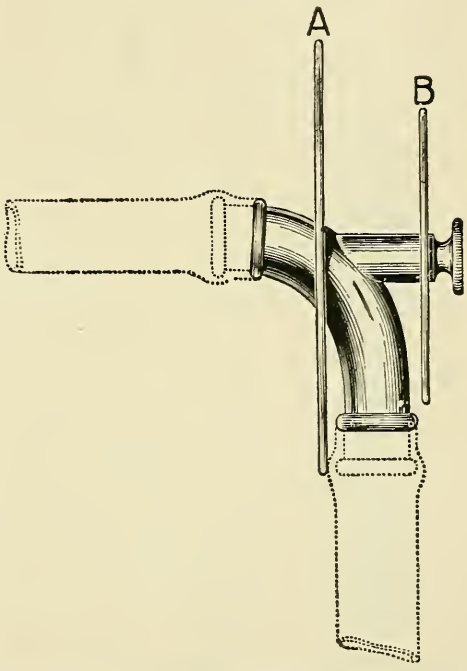

Fig. 166.—Permanent Suprapubic Drainage Tube. A and B are disks, the former at least 8 cm. in diameter.

If the ureter opens just inside the edge of the diverticulum a flap may be cut out so that this flap containing the ureter orifice has a

median attachment to the bladder wall. Its cut edges are sutured so as to close the defect left by removal of the remainder of the diverticulum. But if the ureter opens elsewhere in the diverticulum or is accidentally cut in its removal it must be reimplanted in the bladder.

CHAPTER LXXIV

MEDIAN PERINEAL SECTION

Position of the Patient.—The patient is placed in the so-called lithotomy position, upon his back, with thighs and knees flexed at an acute angle and held in this position by leg supports.

Field of Operation.—The field of operation to be prepared antiseptically includes the pubes, the external genitals, the perineum, and the adjoining portions of the thighs and buttocks. These are prepared by the usual routine of shaving, etc. It is to be remembered that the sensitive skin of the scrotum is greatly irritated by a soap poultice; if used it must not be left in place for more than three hours. In scrubbing the patient upon the table, special care should be taken to clean the preputial cavity and to irrigate the bladder and urethra with nitrate of silver (1:5,000) or permanganate of potassium (1:3,000). It is better to leave some of the fluid in the bladder, in order that this antiseptic may run out from the wound during the operation.

Fig. 167.—Perineal Tube with Terminal and Lateral Eyes.

Special Instruments Required.—A grooved urethral staff, a sharp-pointed curved bistoury, and a perineal tube. The perineal tube is a soft-rubber tube with terminal and lateral eyes, to the tip of which may be sewed the tip of a soft-rubber catheter. The drainage-tube should be size 28 or 30 French, the catheter 15 or 16 French.

Instruments Employed if Local Anesthesia Is Used.—The urethra is anesthetized by the method employed in cystoscopy. In place of the bistoury the surgeon requires a scalpel, artery clamps, grooved director, and female catheter, and the hypodermic syringe, needle, and solution.

The Operation under General Anesthesia.—The operation can readily be done in two minutes, sometimes in one.

The grooved staff is lubricated and introduced well into the bladder to make sure that its point has passed the membranous urethra. It is then withdrawn and held by an assistant in such a manner that its curve projects forcefully against the perineum.

The surgeon feels the staff with the forefinger of his left hand and plunges the curved bistoury into the skin of the perineum in the median line about 5 cm. in front of the anus, driving the point of the knife directly into the groove of the staff just where it begins to curve away from the perineum toward the bladder.

As soon as the knife is felt to strike the staff it is pushed inward along this instrument for about 2 cm. and then drawn outward and backward in such a manner as to make an incision through the urethral mucosa, the overlying tissues, and the skin, just large enough to admit the surgeon's finger. As the knife is withdrawn, the finger is introduced in its place and feels the metal staff within. This instrument is then carefully withdrawn, and as its tip passes from under the surgeon's finger, he presses this finger forward into the bulbous urethra, guided by the roof of the urethra (according to the classical description, the membranous urethra should be opened, but this is never done without very careful preliminary dissection—and incision of the bulb is entirely harmless).

The tight ring of the cut-off muscle is felt, and into this the finger is firmly but gently insinuated, thence into the prostatic urethra and into the bladder. These regions are investigated rapidly for whatever diseased condition is supposed to be present. This investigation may be assisted by counterpressure from a finger in the rectum or from a hand on the hypogastrium.

At the close of the operation the perineal tube is grasped with a dressing forceps in such a way as to bend its tip upward so that this may not catch in the urethral floor at the bladder neck. The bladder is then irrigated through this tube both to clear it of clots and to prove that the tube is properly placed to drain the bladder.

The tube is held in place by a silkworm gut suture, piercing the skin and wrapped several times about the tube.

It will be noted that the bladder is readily cleared of blood unless the internal sphincter has been torn, but that a free venous ooze drips from the perineal wound. The wound should only be drained by a wick of rubber tissue, never packed with gauze, no matter how severe the hemorrhage, for the counterpressure of the dressing upon the perineum readily stops this, while removal of the gauze packed in the urethra is always painful and sometimes excites secondary hemorrhage that requires replacement of the tube and repacking of the wound.

A dressing of gauze is then placed about the tube against the perineum, to be held in place by a T-bandage. It is best to use the so-called "female" T-bandage with a single central piece, which piece is split up just far enough back not to interfere with the perineal tube. Its two ends are laid over the dressing on each side of the tube, crossed in

front of the tube, enough extra gauze laid transversely underneath the scrotum to support this well, and the two ends of the T-bandage carried up and pinned to the waistband in front.

The patient's legs are then let down from the supports, and the efficiency of the perineal tube tested by injection of salt solution or boric acid solution. If it does not flow out, the tube is not inside the bladder, or is plugged with clots. If it flows out in an irregular and intermittent manner, suddenly stopping off and beginning again, the tube has been inserted too far. By pushing in, pulling out, or removing the tube to examine it for clots, it is finally placed at the proper position. In order to avoid such manipulations after operation, the tube, when first placed, while the patient is still upon the operating table with his legs in the air, should be inserted just far enough to run smoothly and then pushed in about 2 cm. farther, and fixed in place.

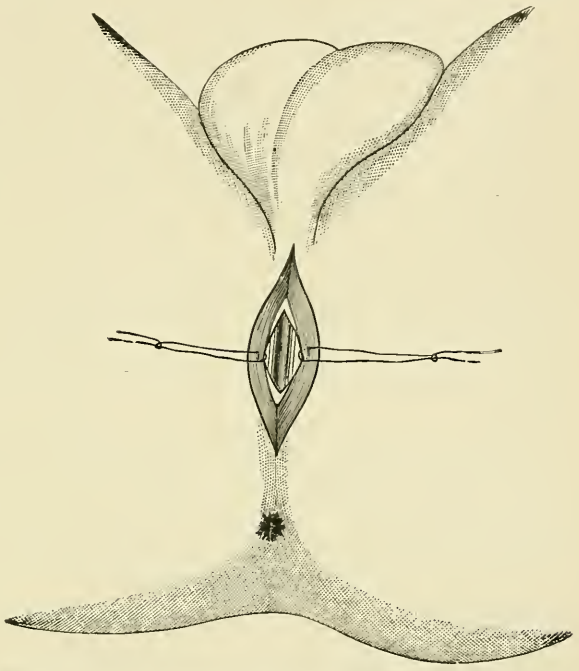

FIG. 168.—MEDIAN PERINEAL SECTION UNDER LOCAL ANESTHESIA. Grooved staff seen between separated borders of incisions. (Bryant.)

Operation under Local Anesthesia.—The urethra is anesthetized as for cystoscopy (p. 51), and at least fifteen minutes permitted to elapse for this to take effect. This time is employed in the final cleaning of the operative field, getting the patient into position, and beginning the infiltration anesthesia.

The skin of the perineum is anesthetized in the median line for a distance of 4 to 6 cm. forward from a point 3 cm. in front of the anus. The skin is immediately incised, and this incision carried down to the muscles surrounding the urethra. These muscles are then infiltrated in the median line and laterally backward, so as to surround the bulb of the urethra with a layer of the anesthetic. Inasmuch as all the nerves run forward, the anterior portions of the deeper wound need

only be anesthetized in the median line, if at all. Indeed, Ilmer [1] has obtained adequate anesthesia by injecting the internal pudic nerve on each side just posterior to the ischial tuberosity.

The grooved staff is then introduced in the manner already described and pressed forward into the perineum. The muscles overlying the urethra are divided in the median line, and after them the spongy tissue of the bulb. One or two arterial branches are cut and may be held in artery clamps, to be tied after the operation is finished. The oozing from the bulb is neglected, and as soon as the staff comes into view this is withdrawn and the finger introduced into the urethra.[2]

Up to this point the operation should be entirely painless; but it is often difficult to force the cut-off muscle with the finger without causing the patient a great deal of pain. This may be obviated by a whiff of general anesthetic, or sometimes, but not always, by infiltration around the membranous urethra with a long hypodermic needle, guided by the finger in the rectum. But, inasmuch as the muscle may be rapidly forced, it is often wiser to tell the patient that one is about to hurt him for an instant, and then to insert the finger rapidly into the posterior urethra.

After the finger has passed the membranous urethra, the prostate and the neck of the bladder may be palpated without exciting pain so long as that part of the finger in the grip of the cut-off muscle is not moved.

The operation is brought to a close in the manner described above. As the skin incision is unnecessarily long, one or two catgut sutures should be taken through the skin, the muscles, and the incised bulbous urethra at the anterior extremity of the incision.

After-treatment.—If the prostate has been removed or the bladder neck otherwise torn, the bladder will fill with clots unless continuous irrigation is used from a tank not higher than a foot above the level of the bed, in which is kept 1 per cent boric acid solution at a temperature of 115° F. The irrigation is managed like a Murphy rectal drip, the inflow being regulated to keep the color of the fluid a light pink. Continuous irrigation is kept up until the fluid has flowed clear from the bladder for several hours.

The tube is removed from the bladder at the end of twenty-four or forty-eight hours, unless some special indication, such as kidney drainage, calls for its retention. After the removal of the tube, the wound is irrigated once with peroxid of hydrogen and water, equal parts.

The anterior urethra and bladder are irrigated daily, both before and after removal of the tube, with boric acid or permanganate of potas-

[1] *Centralbl. f. Gynec.*, May 21, 1910.

[2] The inexperienced surgeon may replace the staff with a grooved director, and along this pass a female catheter from which urine issues, showing it to be in the bladder.

sium solution. As soon as the tube is removed, the patient may sit up if his condition permits. On account of the wound in his perineum he will have to sit upon a rubber ring.

After removal of the tube the patient usually urinates through the perineal wound for from a day to a week or so. Its healing may be hastened by intelligent care. Thereafter the urine begins to come by the urethra; but from time to time, for several days, the perineal wound may burst open, permitting a gush of urine to come through it, and filling the patient with despair. But he may be reassured by the statement that such an accident is to be expected. The urine remains purulent for several weeks, but unless there is considerable inflammation of the bladder or retention of urine, no further instrumentation or washing of the urethra or bladder is employed. It is quite unnecessary to pass a sound unless the operation revealed stricture.

Complications.—Hemorrhage, spasm, and infection are the three complications to be feared.

Hemorrhage does not occur into the bladder unless the bladder neck has been torn. It does no harm if the tube and the bladder are kept clear of clots by continuous irrigation. The bleeding is usually free for the first day, after which it decreases rapidly.

Bleeding from the perineal wound is unimportant unless packing has been inserted, or the prostate badly torn.

Spasm of the bladder is excited by distention of the organ with clots or by obstruction or slipping of the tube. The spasm may also be set up by the mere presence of the tube or of packing in the perineal wound. Clots may be removed by repeated gentle injections and aspirations of hot boric acid solution, or by replacing the tube with a litholapaxy tube and aspirator. After removal of clots the bladder is irrigated with a suspension of Squibbs comp. alum powder (1 part in 10 of hot water) to break up the remaining clots.

If the spasm is due to the mere presence of the tube, the patient should be kept under the influence of narcotics for the first twenty-four hours, and if spasm persists at the end of that time the tube must be replaced with a smaller one or removed entirely. In the latter event the frequent use of the catheter may be required.

Infection is the great danger. It may assume any of the forms of urethral or urinary fever. Our great safeguards are water and hexamethylenamin, nitrate of silver locally, and the perineal tube to supply adequate drainage. It is a good hospital rule that if the patient has a chill or a sharp rise of temperature while the tube is in his perineum, this should be removed. If removal of the tube is followed by a chill no account need be taken of this unless it is repeated or the temperature remains up for more than twenty-four hours. In that event a small tube should be replaced.

PERINEAL SECTION FOR PROSTATIC ABSCESS

The incision is performed in the manner described above. The ungloved index finger of the right hand is inserted into the prostatic urethra, the index finger of the left hand into the rectum and the prostatic lobes are palpated between the two. They are torn open by a gouging motion of the finger within the urethra, which thus lays open the foci of suppuration. If the prostatic lobe has not yet been broken down, but contains a great number of minute, suppurating foci, it will be felt as a spongy, friable tissue. This is crushed into a pulp by two or three sweeps of the finger. It is unnecessary to attempt either antiseptic irrigation or drainage by tube or gauze in the prostatic cavity. The perineal tube is inserted as usual and removed at the end of twenty-four hours. The perineal wound in these cases usually remains open for much longer than usual.

INTERNAL AND EXTERNAL URETHROTOMY WITH A GUIDE

Uncomplicated cases of urethral stricture may require internal urethrotomy, external urethrotomy, or the two together. The preparation and selection of anesthetic for such cases should be subject to the rules of renal function tests, drainage (by preliminary suprapubic puncture or by perineal section without general anesthetic), etc., laid down for prostatectomy.

External Urethrotomy.—The "lithotomy" position is employed, a staff or filiform introduced, and the urethra opened upon this by the scalpel (not the bistoury. Cf. p. 726). A grooved director is then inserted alongside of the filiform, which is withdrawn, and the stricture at the entrance of the membranous urethra incised upon the grooved director, after which the finger is inserted into the bladder. The pulp of the index finger is turned upward and swept along the roof of the urethra, from the forward part of the bulb back into the prostatic portion, and if any lumps of scar tissue are felt in this region they are either divided or cut away. Stricture of the neck of the bladder is recognized as a resisting band through which the finger will not pass. It may be torn through and dilated with the finger. If the bladder neck is torn, continuous irrigation should be kept up for forty-eight hours.

Internal Urethrotomy.—If the stricture is anterior to the bulbous urethra, and impassable to any instrument except a filiform, the Maisonneuve (Fig. 169) urethrotome must be employed. This is screwed on to the end of a filiform, pushed into the bladder, and the knife pushed home. If the stricture of the anterior urethra will admit an Otis urethrotome (Fig. 170), this is introduced (guided, if necessary, upon a

filiform), screwed up to 30 or 32 French, and the knife then pulled out. It is better not to pull the knife out far enough to cut the terminal inch of the urethra, but to reinsert it into its pocket, revolve the urethrotome a half turn and cut the terminal inch on the floor.

Internal urethrotomy should always be performed upon the roof of the urethra. It should not be employed for strictures in the perineal urethra, or at the bulbomembranous junction, unless perineal section is done at the same time.

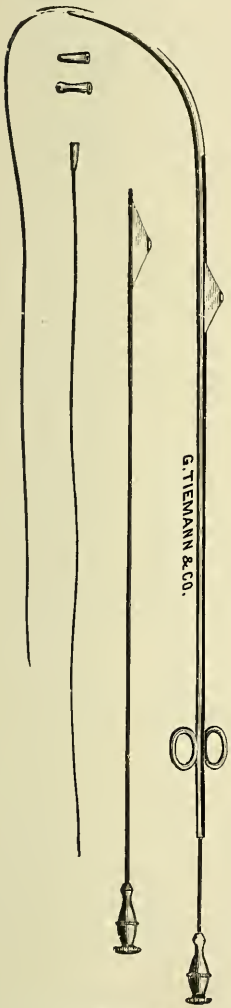

Fig. 169.—Maisonneuve Urethrotome.

If internal urethrotomy is done without external urethrotomy, no instrument should be introduced into the posterior urethra at the time of the operation. If this rule is adhered to, there is no danger of urethral chill or other infectious complication after the operation.

If the *hemorrhage* is alarming and does not soon cease, it may be checked by bandaging the penis and making counterpressure on the perineum against a medium-sized catheter in the urethra. Continental authorities employ internal urethrotomy for strictures in the perineal urethra, and in order to avoid postoperative infectious complications always insert an indwelling catheter for several days after operation.

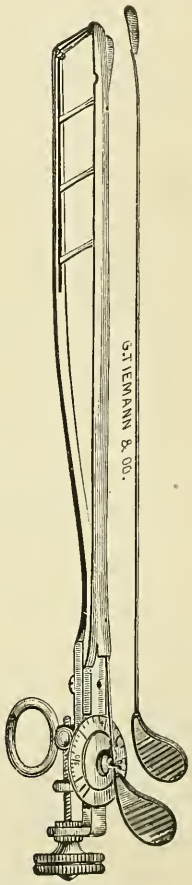

Fig. 170.—Otis Urethrotome.

Internal and External Urethrotomy.—When the stricture requires both internal and external urethrotomy, two courses are open to the surgeon: He may either perform Harrison's operation—i. e., an internal urethrotomy with the Maisonneuve, followed by rapid perineal section, as for drainage, or else he may open the perineal urethra first on a small staff and cut the anterior urethra afterwards. I believe the former operation preferable in most instances.

Passage of Sounds after Urethrotomy.—The rule used to be: "Retain the perineal tube four days. Then pass a full-sized sound. If chill follows, replace the tube for four days more." Such a rule is wrong in two essential particulars: the tube should be removed on the first or second day, the first sound passed between the tenth and fourteenth. A single sound (25 F.) will be found to pass much more readily then than it would have earlier.

If the stricture recontracts tightly before the tenth day, this shows it should have been resected.

Subsequently sounds are passed every fourth day; no more than two sounds being passed on any one occasion. The full size (30 F.) is not reached until nearly a month after operation.

PERINEAL SECTION WITHOUT A GUIDE

Preliminary Sounding.—Every effort should be made to insinuate an instrument through the stricture, both before and after the anesthetic has been administered.

Injection of Methylene Blue.[1]—An 0.5 per cent solution of methylene blue is injected into the meatus and milked along the urethra. Within a minute it will find its way through the tightest stricture into the bladder, deeply staining the tissues as it goes. As much as remains in the anterior urethra is then washed away with sterile water.

The Operation.—The urethral staff is passed into the perineal urethra. If this is impossible a filiform will almost always pass. (Failing this, it is wiser to perform retrograde catheterization than to attempt to find the lumen of the perineal urethra by chance dissection.) The median perineal incision is then made a trifle farther forward than usual, opening the urethra freely in front of the stricture—i. e., between it and the meatus. The urethral walls are then pulled apart by loosely knotted sutures (Fig. 168) or by artery clamps. The urethra is thus pulled flush with the surface of the wound, its floor slit almost but not quite to the orifice of the stricture, and then, guided by touch alone, the surgeon attempts to introduce a probe through the stricture.

It is to be remembered that false passages are likely to be on the floor of the urethra, and they deviate from the median line if upon the side walls. Therefore, the point of the probe should be kept strictly in the median line, and should be guided by the roof of the urethra. Its general direction should be that of the long axis of the patient's body.

If the urethra is pulled well up toward the surface of the perineum, and the maneuver is carried out with care, it almost invariably succeeds. A perineal section without a guide is thus turned into a perineal

[1] This suggestion we owe to Cecil, *Jour. A. M. A.*, 1913, lx, 1606.

section with a guide, as soon as the probe has passed into the stricture; but, even though it passes apparently in the right track, one should not be too sure that it is not in a false passage. The floor of the urethra is carefully divided along the probe; and, inasmuch as the tight band of the stricture is usually very narrow, a slight advance brings one to the dilated portion of the urethra behind, which is readily recognizable, after which protruding masses of scar are cut away and the operation completed as above described.

In case the probe does not pass, two courses are open to the surgeon. The safest method is to do a *retrograde catheterization;* i. e., perform suprapubic section, introduce a woven catheter, or a prostatic sound or catheter with a long curve, into the bladder, and thence into the urethra down to the posterior surface of the stricture. One then returns to the perineum and opens the urethra on the point of the sound.[1]

The second alternative is to continue in the perineum. The so-called Unerring Thrust of Cock, which consists in plunging the knife blindly into the tissues in the general direction of the apex of the prostate, is a hideous mutilation absolutely to be condemned. The best suggestion is Young's. Transform the median incision into a bilateral one by diverging incisions from its posterior extremity; dissect the perineum widely, as in extra-urethral prostatectomy, and upon reaching the apex of the prostate open the urethra there.

If the median perineal section has been performed under cocain, it is sometimes possible to persuade the patient to urinate a drop or two, when close watching will show the hole from which this drop exudes.

THE OPERATION FOR RUPTURE OF THE URETHRA

With the patient in the lithotomy position the hematoma, which fills the median line of the perineum, is incised and the clots evacuated. A small sound is then inserted into the urethra. If the canal has not been completely divided the sound passes into the bladder, the rupture is readily identified, and the operation completed like an ordinary perineal section. But if the urethra has been completely divided the sound appears in the perineum, and wide retraction exposes the end of the urethra. The torn membranous urethra can usually be readily found and a probe inserted into the bladder to be followed by a perineal tube. If the posterior section of the urethra is not immediately recognized suprapubic section and retrograde catheterization should be done. Indeed, there is a growing tendency to treat these cases by suprapubic rather than by perineal drainage. Marion's operation is a type. The

[1] Sinclair has devised an ingenious retrograde-trocar-cystoscope guide to simplify this operation (*N. Y. Med. Jour.*, Apr. 4, 1914).

two ends of the urethra are sutured together with plain catgut while tension sutures of chromic catgut take the strain off the actual line of union of the mucosa. The superficial tissues of the perineum are closed over a good-sized cigarette drain down to the line of suture in the urethra. A suprapubic tube takes care of the drainage for at least ten days after operation.

RESECTION OF THE URETHRA (CABOT'S METHOD)

Cabot's method of urethral resection for stricture is the following: The urethra is disclosed through a median perineal incision and the bulbocavernosus muscle divided longitudinally for a distance of about three centimeters with the tightest point at its center (as indicated by the distance a sound will go in the urethra). The bulb which is thus laid bare is dissected free from the corpora cavernosa, from the triangular ligament forward for two or three centimeters. It is then opened in the usual manner and the stricture carefully divided. With a 22 F. sound in the urethra the mucous membrane and overlying spongy body are then reunited by catgut sutures which close the longitudinal wound transversely thus puckering up the urethra longitudinally and enlarging the stricture. A puncture is then made in the bulb or membranous urethra posterior to this line of suture and a 16 F. soft-rubber catheter inserted into the bladder for drainage (suprapubic drainage is sometimes preferable to this). Cabot advises daily injection of argyrol into the anterior urethra. I believe it preferable to inject nothing. The perineum is, of course, left open and heals by granulation. The first sound is passed at the end of two weeks. The urethra may be found relatively distorted and pocketed, but the sound will readily pass if intelligently used. Cases operated upon by this method certainly seem to recontract much less rapidly than do those that are simply incised.

OPERATIVE TREATMENT OF PERI-URETHRITIS

The principles of the treatment of peri-urethritis are the same whether the infection be nothing more than a small circumscribed abscess or whether it extends as a stinking gangrene throughout the perineum, the scrotum, the pubes, and the buttocks. There is only one exception: the strictly localized abscess may be incised without opening the urethra. But this usually results in a fistula which does not heal until the urethra is actually open (the rule here being thus practically the same as that for the treatment of perirectal suppuration).

For all other conditions the following rules apply:

1. The first incision should be in the median line of the perineum extending from one end to the other of the infected or sloughing mass. If the scrotum is involved this is split. The urethra is thus laid bare on a sound or filiform (methylene blue is very useful in the discovery of the urethra in certain suppurating cases, but phlegmonous infections usually occur about canals that are not very tightly strictured). The urethra is opened at that point at which it is most nearly approached by the infection. If this is not in the posterior portion of the bulb, a second incision had better be made there and the perineal tube inserted in the usual spot.

2. From this central incision radiating cuts in various directions are made over the buttocks, into the groin and through the scrotum and perineum, so as to open every pocket widely. Any pockets that are not freely opened will require a secondary operation.

3. If the cavity is a suppurating one its granulating wall is well curetted. If it is a phlegmonous one, as much as possible of the sloughing tissue is cut away.

The healing of such a wound is, of course, a tedious matter and a secondary operation may be required to close the urethral fistula.

CHAPTER LXXV

OPERATIONS UPON THE PROSTATE AND SEMINAL VESICLES

For several years past I have performed no type of prostatectomy excepting the suprapubic, yet one cannot overlook the brilliant results of Young with his perineal operation. It is questionable whether the intra-urethral method of prostatectomy still holds a place in the modern surgeon's armamentarium. It is certainly possible to remove small intra-urethral prostatic lobes very satisfactorily by this method, and therefore we include it.

SUPRAPUBIC PROSTATECTOMY

The operation of suprapubic prostatectomy was first performed by McGill. Its technic was further developed by my father, by Fuller, by Freyer, and by Squier. The operation, as described below, is shorn of many of the complexities favored by certain operators. It is our impression that the more simply and directly the operation is performed the more rapidly and certainly does the patient get well.

Preparation of the Patient.—The patient with a compensating bladder, in catheter life, comfortably infected, without any acute or chronic complications, and a satisfactory phenolsulphonephthalein output may be operated upon safely with scarcely any preliminary treatment. But such patients are rare. The preliminary treatment is chiefly concerned with accustoming the urinary organs to catheter drainage with its accompanying infection. It is described on page 669. It usually lasts from one to six weeks.

I have kept patients under observation for three months before successfully operating upon them.

Anesthesia.—The Mayos use ether; Young, Cabot, Squier and Lower prefer gas and oxygen, though the last has also used local anesthesia. Chute employs spinal anesthesia. My own present preference, especially for rather desperate cases, is to begin the operation with local anesthesia, continuing this until the bladder wall is reached and suspended with the skin hooks. Then the patient is given gas and oxygen, the bladder rapidly incised and the prostate removed. The general anesthetic is then stopped and, although the patient is awake

almost immediately, the local anesthesia of the abdominal wall gives one plenty of time to suture the wound neatly.

The Incision.—The belly wall and bladder are opened in the usual manner. The incision in the belly wall should almost reach the umbilicus if the patient is fat. But for relatively lean patients a much shorter incision suffices. The incision in the bladder wall must be long enough to admit two fingers.

The Prostatectomy.—The operation can be performed more rapidly with the bare hand though I have removed many prostates with the gloved hand. Two fingers are introduced into the bladder and two fingers of the opposite hand into the rectum (some operators prefer to introduce the whole hand through the belly wall and not to use rectal counterpressure). One should never try to do a prostatectomy with only one finger in the bladder, or only one finger in the rectum; two are required, in the one case to grasp, in the other to balance, the prostate.

With the index finger inside the bladder one searches for the urethral orifice, enters this and pulls it quite sharply upward. As a result the mucous membrane tears over the top of one or other of the lateral lobes. A finger is then inserted in this tear to the outer side of the lobe. If there is no carcinoma the lobe is freed very readily from the tissues above, to the outer side, and below it. The fingers may thus be carried around, tearing the bladder neck as they go, until the top of the opposite lobe is reached. Or if the septa between the lobes are quite dense one lobe may be removed at a time and the other attacked from above downward as the first one was. The bladder neck tears very readily and the only point of attachment that separates with difficulty is the mucosa at the region of the verumontanum. (This tears away just behind the verumontanum.) Counterpressure with the two fingers in the rectum materially assists the manipulation. After all large lobes have been removed one feels carefully for smaller lobes which might, in the course of healing, obstruct the urethra.

If the prostate is small and sclerotic one's first impression may be that there are no outstanding lobes, and that all the patient requires is a division of his bladder neck. But careful palpation will reveal, even in these cases, small lobes within the urethra which must be dealt with in the manner described above, each being removed separately. These small lobes are often very adherent. If the bladder neck still appears to be somewhat tight after this procedure it may be divided in the middle line.

The result of this tearing is a profuse *hemorrhage*. Many devices have been suggested to control this; my father devised one, which he employed only a short time, and I can plead guilty of the same crime. Three methods of controlling hemorrhage find favor at the present time.

One is the Hagner bag.[1] This is an oval bag attached to a long tube, not unlike the Barnes' bag of the obstetrician. It is introduced by forcing the end of the tube over the tip of a Béniqué sound introduced into the urethra and projected out of the suprapubic wound. Before introducing the bag a silk thread is tied to a loop upon it for the purpose of extracting it through the bladder. The sound is withdrawn, leaving the bag inside the bladder. The bag is then blown up with air until it is felt to be comfortably distended, and then by traction upon the tube the bag is drawn snugly into the cavity left by removal of the prostate. The tube is then clamped at the urethral meatus in such a way that a little strip of gauze between it and the meatus suffices to protect the latter, and the bag is held snugly in position. At the end of twenty-four hours the clamp is loosened and at the end of forty-eight hours the bag is removed through the suprapubic wound by traction on the string.

Lower and others control hemorrhage by packing. The packing is inserted, not only into the prostatic cavity, but also against the adjacent bladder neck, pushing this inward into the cavity as far as possible.

Cabot at one time carefully sutured the bladder neck, thereby increasing his mortality. Judd has revived and modernized the Fenwick method of clamping the bleeding points in the bladder neck. But the lengthened anesthesia probably increases the mortality more than the control of bleeding lessens it.

Squier uses no packing. I have very rarely used it, and have only used the Hagner bag a few times. In the great majority of cases the furious initial hemorrhage very rapidly diminishes and in several instances I am sure that the patient has bled more and suffered much more on account of the presence of packing or the Hagner bag in his bladder than he would have done had this not been in place. But if hemorrhage needs to be checked the Hagner bag is the best instrument with which to do it. My own practice is to make compression with a large pad against the bladder neck, forcing this into the cavity left by the prostate for the few moments required to get the suprapubic tube ready, and while the sutures are being placed in the bladder. On removal of this pad of gauze the hemorrhage is usually not very severe.

Closure of Wound.—If the bladder has been much torn a suture or two is taken at the lower end of the incision so as to close it snugly about the suprapubic tube. Tubes of various dimensions are used; I confess to a preference for the large Freyer tube with lumen almost large enough to admit the little finger. This tube permits ready exit to clots and also permits one to introduce forceps into the bladder for the removal of clots in case these accumulate too rapidly to flow out readily. The bladder is attached to the recti muscles and the belly

[1] *Surg., Gyn. & Obstet.*, 1914, lxiii, 677.

wall closed as usual with a cigarette drain in the space of Retzius. If one wishes to use an indwelling catheter from the beginning this should be left in place at the time of operation, for it is very difficult to introduce a catheter through the torn bladder neck until several days after operation. Continuous irrigation should not be employed.

After-treatment.—The large tube is left in place until the subsequent hemorrhage stops and is then replaced by the aspiration apparatus above described on page 718, and this in turn replaced by the indwelling urethral catheter at the end of the second or third week.

EXTRA-URETHRAL PERINEAL PROSTATECTOMY

The modern operation of extra-urethral perineal prostatectomy was devised by Proust. The technic of Young is preferable to that of Proust, inasmuch as Young attacks the prostate through two incisions —one for each lateral lobe—whereas Proust splits the prostate in the median line, thereby destroying the vasa deferentia and getting at the lateral lobes only indirectly.

Although Young uses this operation upon all cases, it is certainly not the operation of choice for the average surgeon—even the average specialist. The prostate obstructs the urethra at the bladder neck. Prostatectomy by the suprapubic route inevitably at least recognizes and mutilates this obstacle, while much prostatic tissue is often removed through the perineum by unskilled operators who do not even reach the obstruction. Moreover the complications of badly performed perineal prostatectomy are much graver than those of the suprapubic operation.

Position of the Patient.—The patient is put in the so-called "exaggerated lithotomy position," the buttocks elevated by tilting up a flap at the foot of the operating table until the perineum is practically a horizontal plane—the legs being so fixed by lithotomy supports that both hips and knees are forcibly flexed.

Special Instruments Required.—The special instruments required for Young's operation are his four retractors, forceps for clamping the prostatic lobes, enucleator, and vesical tractor, also a sound, a staff, and a sharp-pointed bistoury.

Sound.—A sound is introduced into the urethra as a guide.

Incision.—The operation may be performed through a curved prerectal section running from one ischial tuberosity to the other, and passing about 3 cm. in front of the anus (Proust); or one may make two lateral converging incisions and connect them in front by a snip of the scissors (Young).

After incision of the skin and fascia the flap is drawn back and a

finger pushed into the loose cellular tissue on either side of the perineal body. The bulb of the urethra, surrounded by its muscles, is thus fully exposed and the perineal body divided with scissors immediately beneath it. Young's bifid retractor is then introduced posteriorly and strong traction made while the bulb of the urethra is held up and carefully dissected free.

It is most important in this, and the succeeding steps of the operation, to stick close to the urethra, feeling one's way on the sound in that canal. As soon as the most dependent portion of the bulb has been freed (it is identified by its median raphé), *the line of incision turns at a right angle* to strike for the membranous urethra. Otherwise the rectum is opened right here. As soon as the bulb has been freed and drawn well forward, exposing the beginning of the membranous urethra, blunt dissection is made on either side to free the cellular tissue, and the loose muscular bag of rectum is felt adherent to the membranous urethra. A small band of muscle fibers runs from the rectum to the membranous urethra, and this muscular band, the recto-urethralis muscle, is divided *with great care very close to the membranous urethra.*

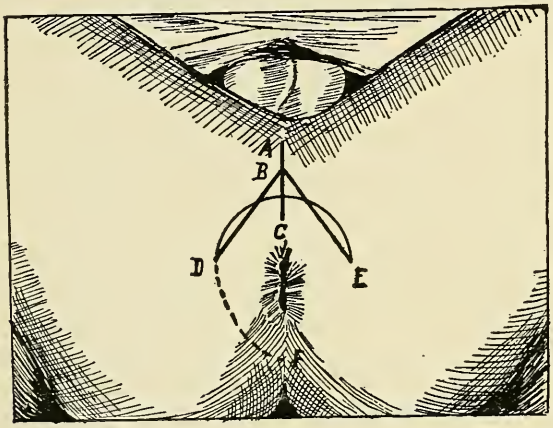

FIG. 171.—PERINEAL INCISIONS. A, C, median incision; D B E Young's incision; D E (curve), Proust's incision; F D E, incision for vesiculotomy.

If the surgeon is in doubt as to his bearings at this point of the operation, he should insert a finger into the rectum in order to feel his way most carefully, for the bowel lies right against the urethra and may easily be opened. As soon as the recto-urethralis is cut, the finger may be swept across the front of the rectum, and this pushed back safely out of the way.

Blunt dissection discloses the prostate. The bifid retractor is now exchanged for the broad posterior retractor, and two lateral, narrow retractors are inserted. Then the blunt dissection is carried upward along the posterior surface of the prostate, carefully following the lines of this organ and pushing back the rectum until the whole of the posterior surface of the prostate has been freed from adhesions and stands out plainly in the wound. It will then be seen that there is a space

about 1 cm. in length lying between the bulb in front and the apex of the prostate behind. The membranous urethra is opened at this point.

In opening the urethra by a stroke of the knife, the unfamiliar surgeon may find it difficult to cut through the mucous membrane. He may be lost in the tissues of the canal, and had, therefore, before performing this step, better remove the sound and replace it by a grooved staff, upon which incision is more readily made. The finger is then introduced into the membranous urethra and thence into the prostatic urethra, and the urethral surface of the gland and the bladder neck carefully palpated as in intra-urethral prostatectomy.

The vesical tractor is now introduced through this incision into the urethra and thence into the bladder, opened, and drawn upward and forward so as to make strong traction upon the lateral lobes of the gland.

According to Albarran's technic, the finger is introduced and traction made with this.

The surgeon now plunges a sharp-pointed bistoury about 2 cm. deep into one lateral lobe near its apex and about 1 cm. from the median line. The knife-blade should penetrate the prostatic tissue close to the urethra, separating the lobe partly from that canal. The knife is then withdrawn with a sweep, dividing the "capsule" of the gland longitudinally for about 2 cm. This "capsule" is fully 1 cm. thick, composed chiefly of posterior lobe, partly of compressed lateral lobe tissue.

The outer surface of the lobe is then freed either by the enucleator of Young or by the finger; and this enucleation is carefully carried well up under the bladder neck in order to enucleate a part, at least, of the median bar or lobe. The loosened gland tissue is then seized with the specially devised forceps and drawn downward, while its outer surface is fully freed.

The inner surface of the hypertrophied lobe adheres strongly to the posterior urethra. If the original incision with the knife has been deep enough, and has reached close beneath the urethral capsule of the gland, these adhesions have been in large measure freed by this incision; but a certain amount of freeing still remains to be done with scissors, and this, if done carelessly, usually results in rupture of the mucous membrane of the prostatic urethra.

Having removed a single lateral lobe in this way, its fellow is removed through a similar incision in the opposite side.

After the lateral lobes have been removed the tractor is removed and the finger introduced into the urethra and through the bladder neck, which is forcibly drawn downward. A finger is then introduced into one of the prostatic incisions, and the region of the bladder neck carefully palpated for further masses of hypertrophied gland tissue. These, if found, are carefully removed.

Young removes middle lobes through one of the lateral incisions by turning his tractor downward and pressing upon them; but other surgeons succeed better by employing the finger as a tractor. Pedunculated lobes should be removed through the urethra.

At the end of the operation a double-current tube is placed in the bladder through the wound in the membranous urethra, which may be closely sutured around it, if it has been unduly enlarged. The incisions of the prostate are carefully packed in order to prevent bleeding; but no extraprostatic packing is required.

In order to prevent subsequent sloughing of the rectum, the edges of the levator ani muscle are caught together by a strong catgut suture. This throws the rectum well back out of the wound. The lateral parts of the external incision are then closed up to the central point, whence the perineal tube and gauze issue.

Difficulties of the Operation.—A fibrous lobe is very difficult to remove without tearing the prostate all to pieces, and an obstruction due to median bar should certainly not be attacked by this method. Pedunculated median lobes cannot be conveniently gotten out through this incision.

Injury to the rectum may occur at the time of the operation. I tore the rectum in the first three cases in which I operated by this method. The wound should be promptly sutured, and special care should be taken to bring together the levator ani muscles in front of the bowel. In my three cases the wound in the bowel healed kindly, but others have not been so fortunate. Young states that if the bowel is opened one should abandon the perineal for the suprapubic route.

After-treatment.—Continuous irrigation is maintained through the double current tube for about six hours; the gauze drains are removed at the end of eighteen hours; the perineal tube at the end of twenty-four or forty-eight hours; and the patient is then promptly gotten out of bed if that is possible.

Postoperative Complications.—The special postoperative complications are hemorrhage, rectal fistula and incontinence of urine.

Intravesical hemorrhage does not occur if the operation has been properly performed, but several deaths have occurred from hemorrhage into the wound. This is likely to occur only in old, septic individuals, for whom extra-urethral prostatectomy is not peculiarly suited, except at the hands of an expert.

It is stated that the bowel may slough after operation, or that the rectal tube may be forced through it. I question the probability of either accident unless the bowel was injured at the time of operation.

The postoperative *treatment of urethrorectal fistula* consists in keeping a small catheter in the perineal wound in the bladder for about a week and at the same time keeping the bowel as clean as possible by

daily irrigations with saline solution. At the end of a week the small catheter in the perineal wound is replaced by an indwelling urethral catheter while rubber tissue drains are so applied in the perineal wound as to prevent pocketing and encourage the earliest possible healing. Under these circumstances the wound often heals perfectly. If it does not, a subsequent operation for urethroperineal or rectoperineal or urethrorectoperineal fistula may be required (p. 764).

Incontinence of urine follows prostatectomy only when the external sphincter has been injured. It does not occur after a properly performed prostatectomy of this type though it is not uncommon after intra-urethral perineal prostatectomy.

INTRA-URETHRAL PERINEAL PROSTATECTOMY

Ten years ago this operation threatened for a time to become the operation of choice for prostatectomy. But even its ablest exponents find it a dangerous procedure (hemorrhage, incontinence) for the removal of large or intravesical growths. For the removal of small intra-urethral adenomata it is an admirable procedure.

Incision.—A rather long median perineal incision is made upon the urethral staff. If palpation has shown that the perineum is not very deep, I prefer to open the bulbous urethra as in external urethrotomy; but the custom of most surgeons is to separate the bulb by section of the median perineal body and to draw it forward, bringing the membranous urethra into view. The urethra is then opened at this point, dividing practically the whole of the membranous urethra in the median line behind. The staff is then withdrawn and the finger introduced.

Examination of the Prostate.—The finger then enters the prostatic urethra and estimates the nature of the obstruction at the neck of the bladder, verifying the accuracy of the preliminary cystoscopy. In order to do this properly, the finger must be introduced into the bladder and swept around the bladder neck on all sides—a maneuver which is very difficult if the perineum is deep, and which tears the bladder neck if this is strictured; it is made easier by counterpressure on the hypogastrium. The finger is then withdrawn and palpation of the lateral lobes made upon a finger in the rectum. In no other way can their size and shape be correctly estimated.

Removal of the Obstruction.—If enlarged lateral lobes are felt, these are removed as follows:

A curved, sharp-pointed bistoury is introduced into the prostatic urethra on the finger until its point is opposite the most bulging portion of the lateral lobe. It is then plunged into that lobe to a depth of at least 1 cm. and drawn out, making a deep, longitudinal incision in the

lateral wall of the urethra. The knife is then withdrawn and the finger reintroduced. If the incision has been deep enough, the finger feels the lobulated tissue of the hypertrophied gland and proceeds to remove this in the following manner:

The finger is first worked outward between the hypertrophied tissue and the so-called capsule, its movement being directed by the sensation of lobulated tissue on one side and smooth capsule on the other. The lobe usually separates very readily on the outer side and the finger is rapidly swept up and down until the lobe is quite free on its outer aspect. A sponge-forceps is then inserted, and the lobe grasped and pulled down gently (too great traction only tears the tissue), while the finger reaches farther and farther upward, dissecting around the upper end of the lobe. Finally, the whole lobe is freed except that part of it adherent to the mucous membrane. This is freed as much as possible, but pieces of it usually adhere to the lobe when it is finally removed by the forceps.

The same maneuver is then performed on the opposite side.

If there is general enlargement of the gland, the dissection of the outer aspect of one lobe naturally carries the finger underneath the median bar and over to the other side of the urethra. The whole prostate should not be removed in one piece, for overstretching of the membranous urethra is carefully to be avoided. Pedunculated median lobes may be caught in the volsella and removed by snipping the mucous membrane at their base with long scissors.

The operation is closed by the introduction of a double-current drainage-tube. Gauze packing to control hemorrhage is not required if the operation is confined to the removal of small adenomata.

Difficulties in the Operation.—Difficulties in enucleation of the hypertrophied tissue may usually be overcome by firmly grasping the lobes in the volsellum. In some cases deep hypogastric pressure is of great assistance, or a finger in the rectum may help; but if the perineum is very deep and the projection of the prostate largely intravesical, the Syms bag is a great help in drawing down the gland. This bag should be filled with water, not with air. Its tube is then clamped and drawn upon firmly during the operation as a retractor.

If the lobes under process of enucleation are not tightly grasped by the forceps, they may slip into the bladder unless the Syms bag is used. They are best removed by a lithotomy forceps.

Careful operation will always avoid the one grave difficulty of the procedure, viz., tearing into or through the capsule of the hypertrophied lobe. If this accident should occur, it is recognized by the fact that the finger passes into a space on all sides of which the tissues are smooth, and in which none of the lobulated, hypertrophied gland can be felt. Such a tear should be closely packed with gauze, in order to avert

hemorrhage; otherwise, no gauze packing is required. Tearing of the bladder neck should be avoided as far as possible, though some tearing of this part of the urethra is usually unavoidable.

Postoperative Care.—Continuous irrigation must be begun immediately—before the patient leaves the operating table; otherwise clots may accumulate before the patient gets into his bed, which cannot be removed without great difficulty, and may require suprapubic section. Irrigation is kept up until the fluid no longer returns bloody, and for at least six hours after operation.

It is usually better to remove the perineal tube within two days after operation, though if there is very marked cystitis and the patient's condition is good, the tube may be kept in a longer time; but it is of the greatest importance to get the patient out of bed as soon as possible.

It is well to pass a single, full-sized sound into the urethra at the end of the first or second week after operation, to be sure that no tendency to stricture formation is occurring during the healing, although stricture is a very unusual complication of the convalescence. Watson states that he knows of only 6 cases of stricture of the prostatic urethra following this method of perineal prostatectomy.

Postoperative Complications.—The immediate postoperative complications of hemorrhage and urinary septicemia should be dealt with according to the rules laid down above and in Chapter LXIX.

The complications especially to be feared after this operation are epididymitis, impotence, incontinence of urine, and persistence of retention. The first two may follow any form of prostatectomy.

Urinary Incontinence.—A minor degree of incontinence of urine —i. e., a lack of tightness in urination, whereby the patient may lose from a few drops to a teaspoonful or so every day—is a complication of moderate frequency after this form of prostatectomy. It is due to the cutting and stretching of the membranous urethra.

Total incontinence ensues when the internal sphincter has been badly torn.

Retention of Urine.—Failure to relieve the prostatic obstacle is due to overlooking a bar or lobe at the bladder neck.

OPERATIONS OTHER THAN PROSTATECTOMY FOR THE RELIEF OF OBSTRUCTION AT THE BLADDER NECK

For reasons already given, I believe prostatectomy preferable to any other operation for prostatism in any of its forms even when the contraction of the bladder neck by sclerosis seems to be the chief lesion, and the enlargement of the lateral lobe relatively insignificant.

But even with this restriction there are cases, notably of stricture

at the bladder neck after prostatectomy, not amenable to prostatectomy. Such a scar may be relieved by a deep incision of the bladder neck made through a suprapubic or a perineal opening. In order to avoid the very annoying hemorrhage that results from so deep a cut various operations have been proposed. I give them in the order of my personal preference, omitting the Bottini operation since that has fallen into general disfavor:

Galvanocauterization of the prostate (Chetwood).

The prostatic punch (Young).

The D'Arsonval current (Bugbee).

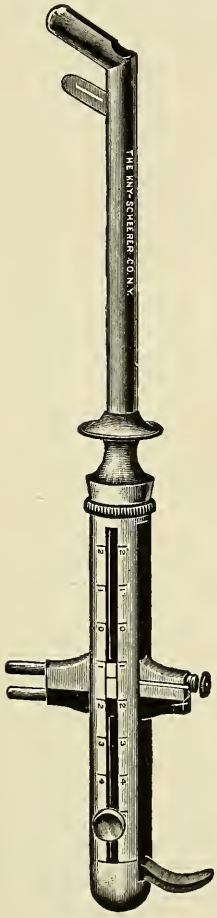

Fig. 172.—Chetwood's Prostatic Incisor.

GALVANOCAUTERIZATION OF THE PROSTATE

Incision in the bladder neck by cautery has the double advantage of not bleeding and of healing so slowly that the burned groove leaves practically the same opening in the bladder neck as is felt at the time of operation. The neck of the bladder should be cauterized after perineal incision and palpation of the obstruction according to Chetwood's technic.

The blind Bottini operation should never be performed.

The Perineal Section.—The urethra is opened by a median perineal section and the prostate explored.

The Galvano-incision.—The accompanying figure shows the instrument employed (Fig. 172). It resembles a short, stout Bottini incisor, the knife of which is drawn out by the surgeon's direct pull instead of by a ratchet wheel. The length of the incision is regulated by a small stop-pin, which may be set at any desired point. The battery is the same that is required for the Bottini operation.[1] It is essential to allow a stream of cold water to course from the meatus through the urethra and out of the perineal wound while the burning is being done. Otherwise traumatic stricture will result from overheating of the perineal urethra. The instrument must be tested before using in order that the amount of electricity required to heat the knife to a white heat may be justly appreciated.

The surgeon introduces the instrument into the perineal wound,

[1] It should give a constant current of 4 volts, 50 ampères.

and turns it to hook over the prostate in the required direction. He then inserts the index finger of his left hand (protected by a rubber glove) into the rectum, and bears down with the point of the instrument until it can be distinctly felt on the front wall of the rectum above the prostate.

The cooling apparatus having then been adjusted and only a very small stream of water being allowed to flow, all is ready to begin. From this point it is best to proceed by the watch. The electricity is turned on, and five seconds are allowed for the knife to become heated. It is

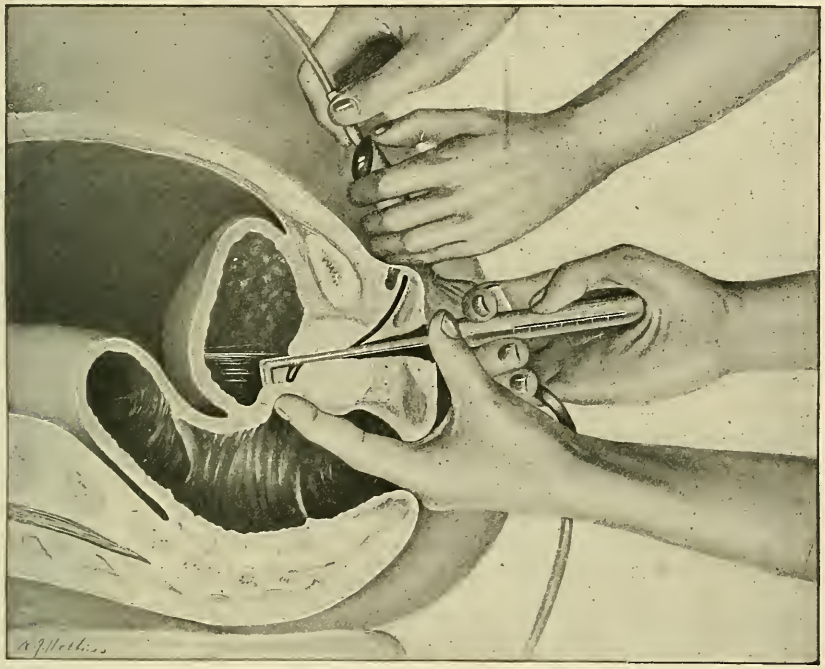

Fig. 173.—Chetwood's Perineal Galvanoprostatotomy.

then very slowly withdrawn [1] (Fig. 171), from sixty to ninety seconds being employed in drawing it out, and fifteen seconds for its return. The instrument is then extracted, the cold-water nozzle inserted into the perineum, so as rapidly to cool the incised tissues, and then a finger is introduced into the wound and the groove carefully palpated. It should extend on an even plane from the trigone to the urethral floor, completely dividing the bar.

Frequently, all the tissues will be found divided with the exception of the urethral mucous membrane, which is readily torn by the finger.

[1] The length of the incision varies from 0.5 to 3 cm. If in doubt, the surgeon may better make a short incision first and lengthen it later.

But if a dense bar remains this should be divided by a second cauterization.

A double-current perineal tube is inserted and *after-treatment* conducted as for perineal prostatectomy.

Complications.—There are no operative complications peculiar to this procedure. The postoperative complications are similar to those of perineal prostatectomy. Some surgeons find the operation peculiarly productive of incontinence of urine. I have employed it 50 times,[1] with but 2 deaths, and 3 cases of grave incontinence. I have once seen

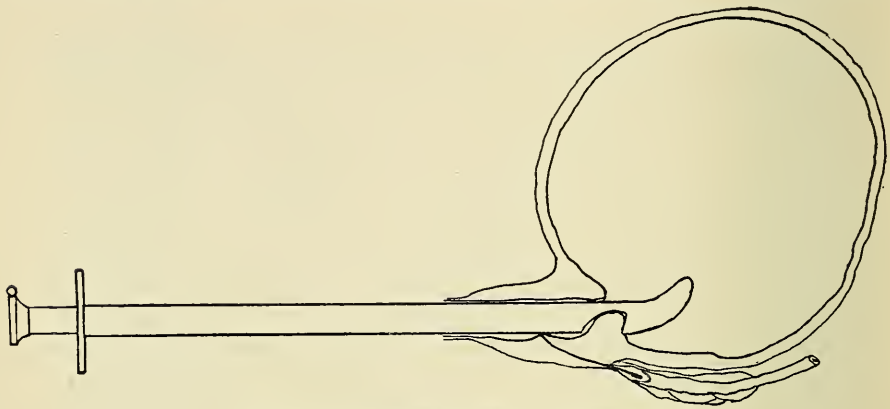

FIG. 174.—YOUNG'S PROSTATIC PUNCH.

a stricture result from omission of the cooling water. Dr. Chetwood's series shows about the same results.

THE PUNCH OPERATION (YOUNG)

The operation is performed in the cystoscopic position, under local anesthesia.

The bladder is filled with 1 to 100,000 bichlorid of mercury solution and the operating urethroscope, with the obturator in place or with the inner tube pushed home so as to fill the fenestra, is inserted until the beak is felt to enter the bladder for a very short distance. The inner tube is then withdrawn about 1.5 cm., enough to uncover the fenestra and the cavity is dried with swabs. A small portion of the floor of the urethra is generally seen bulging into the fenestra, sometimes the verumontanum. The instrument is then gradually pushed deeper, the operator at the same time looking through the tube until finally the median bar is seen to "pop" into the fenestra. This is generally accompanied by the escape of a small amount of fluid from the bladder into the tube, but by drawing the instrument slightly outward this is stopped and the median bar is found firmly held in the fenestra by its hooklike inner margin (Fig. 174). The inner tube is then simply pushed home and a distinct

[1] *Trans. Am. Urol. Assn.*, 1913, xiii.

resistance will be met with while a large section of the median bar is thus divided. Without removing the instrument the rongeur forceps are inserted and the excised specimen removed. It is generally advisable to make the cut on each side of the median line obliquely outward and backward in order to completely remove the bar, and on this account the instrument is first turned 45° to the right, the inner tube partly withdrawn, the field dried with a swab, and then inspected to see that the desired portion has been entrapped, when the tube is again pushed home and the section removed as before with the forceps. The left lateral oblique portion is similarly removed.[1]

A double-current urethral catheter is then introduced and continuous irrigation immediately instituted through this. The bleeding may be very sharp and can only be controlled through this catheter by incessant watchfulness and repeated injections and aspiration of clots, if necessary. The catheter is usually left in place for at least three or four days.

URETHROSCOPIC CAUTERIZATION OF THE BLADDER NECK

Bottini devised a most efficient cautery but his operation has fallen into disfavor because the extent of cauterization could not be controlled. Chetwood placed the operation upon a sound footing by adding a perineal section and the control of palpation both before and after the cauterization. Goldschmidt, Wossidlo,[2] Bugbee,[3] Day,[4] and others have employed various forms of electricity for the purpose of burning away strictures at the neck of the bladder under urethroscopic observation. The D'Arsonval current is usually employed through a cystoscope or urethroscope permitting observation of the bladder neck and with a lever attachment which will direct the wires to make pressure against projecting portions of the bladder neck so as to burn through them. The wire is pressed well down into the tissues until it is seen to sink into them in a groove and until no further bubbles ascend, showing it has burned as deeply into the tissues as may be. Intermittent catheterization is then continued so long as the obstruction requires it.

PROSTATECTOMY FOR NEOPLASM

Extirpation of prostatic carcinoma requires removal of the whole prostate together with its capsule. This operation was first performed by Leisrink in 1882, a similar operation was performed by Fuller in 1898, and the technic has been finally perfected by Young (1904).

[1] *Trans. Am. Assn. G.-U. Surg.*, 1908, iv, 231.
[2] *Surg., Gyn. & Obstet.*, August, 1915, p. 208.
[3] *N. Y. State Medical Jour.*, 1913, xiii, 410.
[4] *Jour. A. M. A.*, 1915, lxv, 1797.

Instruments Required.—The instruments required are practically the same as those used in extra-urethral prostatectomy.

The Operation.—The patient is put in the extreme lithotomy position, and the prostate exposed as for extra-urethral prostatectomy. But the separation of the rectum from the prostate should be carried not only to the upper end of that gland, but over the seminal vesicles as well. After these structures have been thoroughly freed, the incision is made in the membranous urethra and Young's tractor introduced into the bladder and opened. The handle of the tractor is then depressed and the membranous urethra divided transversely close to the apex of the prostate.

By further depressing the handle of the tractor, the puboprostatic ligament is exposed and easily divided by scissors, thus completely separating the prostate from all important attachments (except posteriorly). The lateral attachments, which are slight, are easily separated by the finger. The posterior surface of the seminal vesicles is then freed by blunt dissection, the now mobile prostate being drawn well out of the wound. (Young.)

The mass is then drawn strongly downward and the neck of the bladder is incised in the middle line in front, and about 1 cm. above the prostate. The incision in the bladder wall is continued down on each side until the trigone is exposed. The ureters are searched for and the line of incision carried across the trigone so as to pass 1 cm. in front of the ureter orifices. By blunt dissection the base of the bladder is then pushed upward from the anterior surface of the seminal vesicles and vasa deferentia. These are then freed from the bladder, leaving as much of the fat and areolar tissue attached to the vesicles as is possible. The vasa deferentia are drawn down by a blunt hook and divided as high up as possible, care being taken not to damage the ureters. The seminal vesicles then come down more easily. Their upper ends are ligatured and the whole mass removed.

Reconstruction of the vesico-urethral gap is now necessary. The stump of the membranous urethra is identified by the passage of a catheter from the meatus. The bladder, which has retracted far up into the pelvis, is caught with forceps and drawn down again.

The first suture is placed by inserting the needle through the triangular ligament above the urethra, and then out through the anterior wall of the membranous urethra, then through the anterior wall of the bladder in the median line from within out, care being taken to include only the submucosa and the muscle. This leaves the knot outside the junction of the two approximated edges. The thread is left long. Lateral sutures, including the periurethral muscular structures below, and two posterior sutures, complete the anastomosis of the membranous urethra with a small ring into which the anterior portion of the margin of the vesical wound has been fashioned by tying the sutures. The remainder of the vesical wound is now closed with sutures. (Young.)

The wound is freely drained with gauze, its lateral branches being closed. A small perineal tube should be left in for a week.

OPERATIONS UPON THE SEMINAL VESICLES

The same incision as that used by Young for prostatectomy is admirably adapted to operations upon the seminal vesicles. The operation is begun in the manner described above. The rectum should be separated from the urethra not only as far as the prostate, but also beyond it, to reach the seminal vesicle. The section should hug the prostate and vesicle. When the vesicle is reached it may be incised (vesiculotomy) or excised (vesiculectomy). As the wound is very deep the vesicles are brought more fully into view by catching a suture in each of the lateral angles of the prostate and making traction upon this.

Vesiculotomy.[1]—The vesicle is thoroughly exposed by division of the fascia of Denonvilliers and split from end to end and its interior curetted. A tube is sutured into this cavity and led out through the perineal wound, which is closed in the usual manner. This drain is kept in for a week.

Vesiculectomy.—The sheath of the vesicle is split and the organ freed by blunt dissection. It is divided at its entrance into the prostate and extracted after ligature of the artery at its fundus. The vas may be divided and extracted with it; and, if preliminary castration has been done, the whole of the vas may be pulled out through the urethral wound. If the fundus of the vesicle is adherent, its enucleation may be simplified by dividing it as it enters the prostate and endeavoring to shell it out from below upward; but this maneuver may be extremely difficult, and, inasmuch as the vesicle lies immediately below the peritoneum and is probably adherent to this, rather than risk opening the peritoneal cavity, it may seem wiser to amputate only as much of the vesicle as can readily be freed, and to be satisfied with curetting or cauterizing its remains.

[1] Cf. Squier, *Cleveland Med. Jour.*, 1913, xii, 801; also Barney, *Trans. Am. Assn. G.-U. Surg.*, 1914.

CHAPTER LXXVI

INTRAVESICAL OPERATIONS

LITHOLAPAXY

Anesthesia.—Small stones may be crushed under local anesthesia, such as is employed for cystoscopy. The operation is then best performed with the Chismore combined lithotrite and pump.

For multiple stones, stones more than 3 cm. in diameter, or complicated cases, general anesthesia is preferable.

Instruments Required.—Besides the usual antiseptics, etc., a kit for suprapubic section should be at hand and one should carry all special instruments, lithotrites, evacuators and tubes, in duplicate.

Lithotrites.—The lithotrite (Fig. 175) is called upon to perform two very different functions—viz., to crush a stone of some size and perhaps of great hardness, and to catch and crush small crumbling fragments that are only just too large for aspiration. For the former purpose a heavy, powerful lithotrite with a fenestrated female blade (Fig. 176) is required, while for the latter I prefer a lighter instrument with a solid female blade of a broad duck-bill shape. A complete outfit should include these and several intermediate varieties of lithotrites, as the surgeon's judgment dictates. Small lithotrites are made for children.

The powerful lithotrite should possess several characteristics: (1) The male blade when screwed home should pass quite through the female blade: an instrument thus constructed cannot become clogged; (2) the wheel (Fig. 175) or globe (Fig. 176) handle of the instrument must be large enough to afford firm purchase for the surgeon's hand; (3) the catch for adjusting the screw action should be sufficiently prominent to be worked without the least difficulty. In my father's instrument (a modification of Réliquet's) the catch is saddle-shaped (Fig. 175). Chismore had added to his lithotrite an automatic hammer such as dentists use, and with it claims to crush the hardest and largest stones with scarcely any effort.

For small, *soft* fragments a flat-bladed, duck-bill instrument is useful. This instrument should only be employed toward the end of the operation. The nonfenestrated blade has a tendency to clog, but this

instrument will, in my hand, pick up fragments that no other lithotrite will catch. For small, *hard* fragments I employ a light, small-bladed fenestrated instrument.

The Evacuator.—The evacuator or washing-bottle of Bigelow (Fig. 177) I prefer to any other. The evacuator of Chismore is an excellent instrument.

Washing-tubes.—Litholapaxy has been restricted by modern surgery to such simple cases that almost any standard washing-tube is adequate. I have employed Bigelow's, my father's, and Guyon's with equal success.

The Operation.—This is litholapaxy: To catch the stone with an instrument passed through the urethra, to fragment it sufficiently for the detritus to pass out through a tube, and to suck this out by some suitable apparatus.

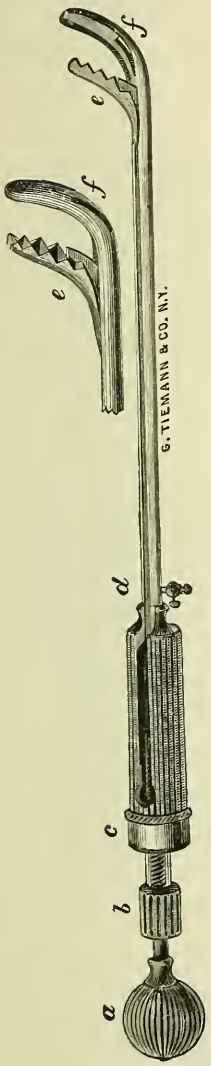

Fig. 175.—Bigelow Lithotrite.

The patient is placed upon the operating table on his back, with his feet widely separated and a sand bag beneath his hips. He is then catheterized and 100 to 150 c.c. of warm boric acid solution injected into the bladder. A lithotrite, selected in accordance with the size of the stone, is then introduced (Fig. 178). It may have to be assisted over the prostate by pressure on the perineum.

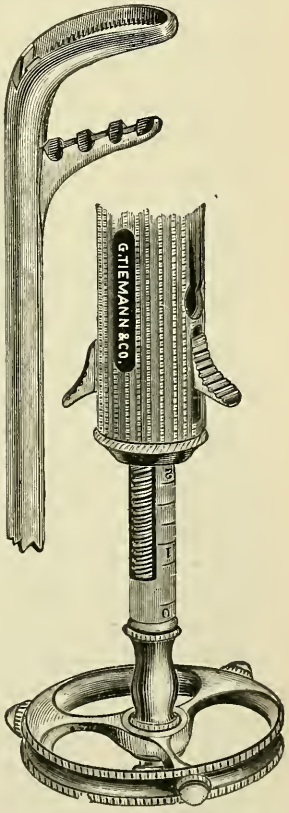

Fig. 176.—Keyes Lithotrite.

The surgeon must remember that the specific gravity of the stone is scarcely greater than that of the water in which it floats. The least violent move of the lithotrite dislodges the stone; only by the most gentle and deliberate movements can it be grasped.

Once in the bladder the lithotrite is passed gently onward until it

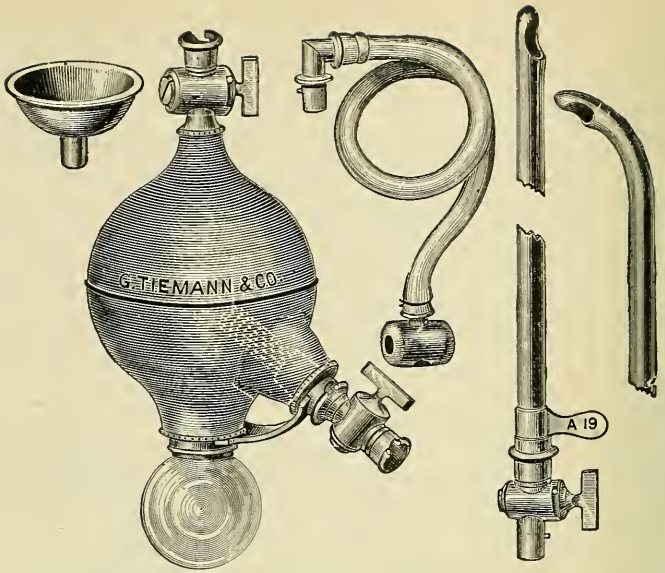

Fig. 177.—Bigelow Aspirator and Washing-tube.

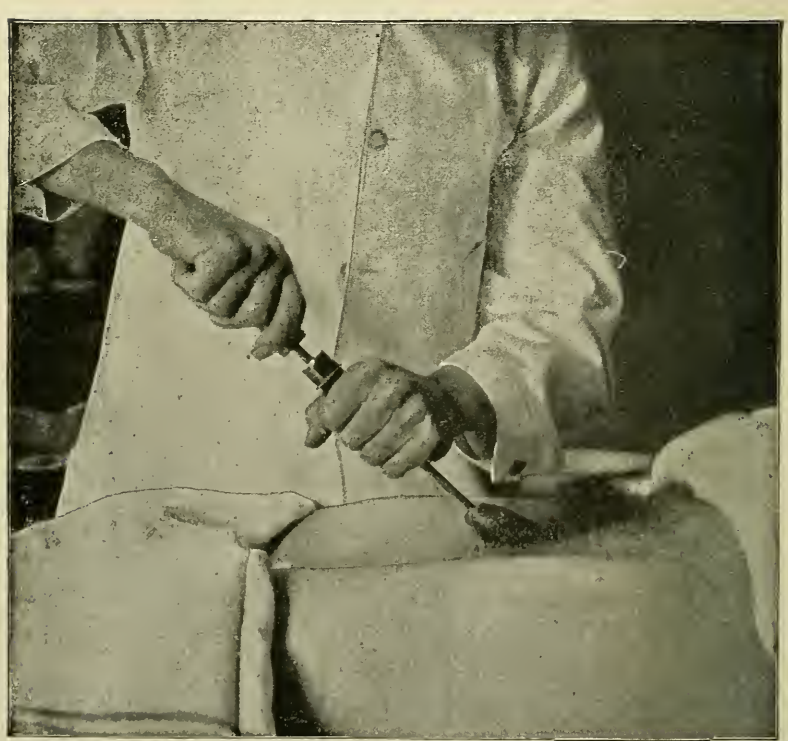

Fig. 178.—Showing the Manner of Holding the Lithotrite when Opening and Shutting in the Search for Fragments. (Morrow.)

touches the wall of the fundus. The male blade is then gently withdrawn until this comes in contact with the superior wall of the bladder neck, the handle of the instrument is then gently elevated so that its female blade forms a pouch in the fundus of the bladder. The instrument is thus held for a brief moment, then the male blade is very slowly and gently pushed inward and the stone will usually be found within the grasp of the instrument.

The screw power is then turned on, the handle given a fraction of a

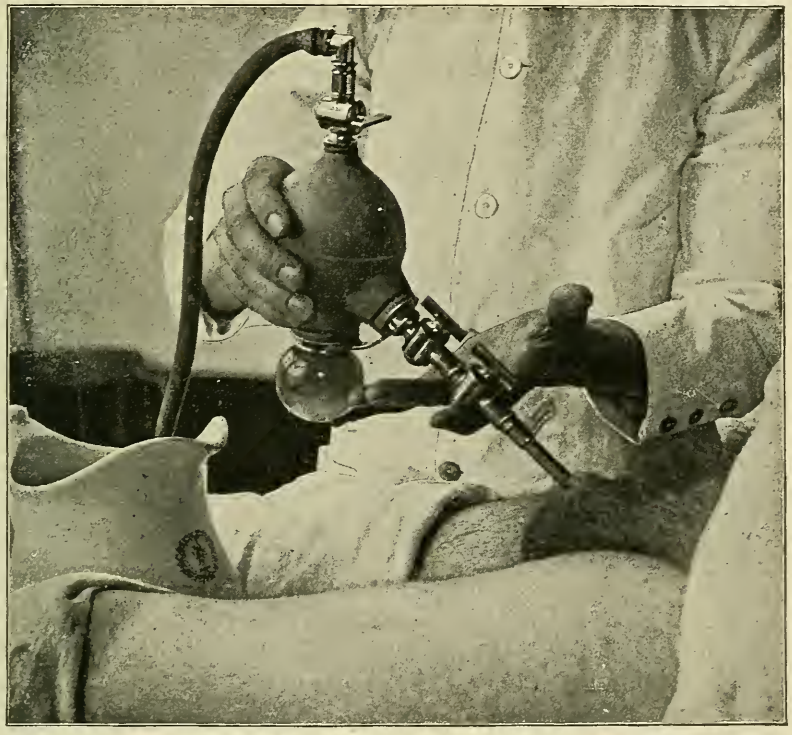

Fig. 179.—Showing the Manner of Holding the Bulb. The Left Hand Holds the Weight while the Right Manipulates It. (Morrow.)

turn to grasp the stone tightly and the whole instrument then withdrawn toward the neck of the bladder to prove that it has not caught any of the mucous membrane in its grasp. If the instrument moves freely its screw handle is then turned slowly and intermittently until the stone crumbles into fragments. The female blade is then returned to its original position, the male blade withdrawn and the maneuver repeated as often as fragments are thus caught and crushed. From one to six such crushings are usually required to reduce the stone to small fragments. Then the lithotrite is once again passed to the fundus, and the male blade withdrawn to the bladder neck while the instrument is

held as before with its blades in the median line. Then it is turned at right angle to the right side and the male blade gently returned toward the female. Small fragments are usually encountered and crushed by this maneuver which is repeated first on one side and then on the other until fragments larger than 1 cm. in diameter are no longer caught. In some instances the last large fragment can only be caught by reversing the blades and closing them with the instrument upside down.

All of these maneuvers must be conducted with the utmost slowness and gentleness.

The lithotrite is then withdrawn and the evacuating tube introduced and attached to the evacuating bottle full of boric acid solution. With the eye of the tube just inside the bladder neck the bulb is given a sharp pinch of sufficient strength to evacuate perhaps one-third of its contents, and immediately released. As the rubber reëxpands the solution rushes from the bladder into the evacuator carrying with it the fragments of stone which sink into the glass collecting bottle at its bottom. This maneuver is repeated until no more fragments come away, and continued thereafter a few times while the operator notes whether any click against the tube announces the presence of any further fragments in the bladder. If he believes he has exhausted most of the stone, or all of it, a lithotrite with a solid female blade is introduced and put through the same motions as above described. Whether any fragments are thus caught and crushed or not it is wise once more to evacute so as to certify the removal of the last fragment. It is then prudent to close the operation by the introduction of a cystoscope whereby the bladder can be visually examined and the absence of stone proven.

The unaccustomed operator may be misled by the click produced when the bladder wall catches in the eye of the tube. This is a muffled double click with a pull to it quite distinct from the single sharp click of a stone fragment. By moving the eye of the instrument to another part of the bladder, contact with its wall is readily avoided.

The operation is concluded by an irrigation with 1:2,000 silver nitrate solution.

If the bladder neck has been so bruised that the fluid contains blood, a catheter should be tied into the urethra and left there for twenty-four hours, or longer if there is residual urine. But in most instances the bleeding within the bladder is very slight and no after-treatment is required.

Difficulties and Complications.—If the stone cannot be grasped it is doubtless adherent to some part of the bladder wall, and suprapubic section had better be done forthwith. The same resort is open to the surgeon who fails to remove the last fragment or breaks his lithotrite

(this accident never happened to my father in 150 operations; it has happened to me once).

I have once seen excessive hemorrhage in the course of a litholapaxy due to the presence of an unsuspected bladder tumor.

I know no operation of which the success depends so entirely upon the surgeon's skill and technic. What is most difficult to the novice is to crush the stone methodically and deliberately. The first catch and crush is usually easy, and perhaps in a given case it would be possible for an unskilled operator to make quick work of the larger fragments without any particular method; but long before the last fragment has been crushed such an operator will find himself pottering about in the bladder, never finding any considerable fragment, although the clicks upon the tube assure him that there is plenty of work left to do. This deadlock may continue quite indefinitely, and the only way to avoid it is to know in exactly what part of the bladder the stone tends to lie and in exactly what part of the bladder the beak of the lithotrite is.

After-treatment.—The course of water and hexamethylenamin is resumed as soon as possible after operation.

The irritability of the bladder the first few days may be controlled by morphin or by opium suppositories. Nitrate of silver irrigations afford great relief.

It is unwise to let most patients get up before four days have passed. I have in exceptional instances turned my patient out on the second day. I have indeed operated in my office several times under local anesthesia —and with no anesthetic in the case of small stone—but this again only in exceptional cases.

The after-treatment cannot be considered complete until the patient has been cystoscoped for stone one month after the operation, nor can any assurance be given that no fragment has been left behind until this search has been performed.

Postoperative Complications.—After litholapaxy all the complications may occur that are met with after the various operations upon the urinary tract: retention, hemorrhage, urethral fever, cystitis, prostatic abscess, epididymitis, or even the graver complications, suppression, surgical kidney, even pyemia and septicemia; but the occurrence of such complications indicates that the surgeon's skill does not equal his zeal. I have never lost a case of litholapaxy.

Relapse after litholapaxy may occur from one of three causes: (1) A fragment may be left by the operator; (2) a new stone may come down from the kidney; or (3) reaccumulation may occur behind an enlarged prostate.

HIGH FREQUENCY CAUTERIZATION OF BLADDER LESIONS

Since the introduction of the high frequency current used through the cystoscope as a means of attacking lesions of the bladder and urethra by Beer,[1] this treatment has been applied, not only as first suggested for the cure of papillomata, but also for the healing of ulcers, the explosion of stones, and the cure of granulomata in the urethra as well as the destruction of obstructions at the bladder neck whether due to simple prostatism or to carcinoma.

Fig. 180.—Operating Cystoscope.

The technic for burning the bladder bar has been described on page 749; that for urethral granulomata and bladder papilloma is described below. The attack upon simple or tuberculous ulcerations by this method is not particularly satisfactory. I have healed with it one case of simple ulcer, but failed in several others.

The cauterization of bladder papillomata requires the following instruments:

A cystoscope (preferably of the so-called operative type); an insulated wire or flexible metal probe, and an electrical source for the high frequency current are needed. The cystoscopic and electrical instruments made by Wappler are usually employed. Inasmuch as diagnosis as well as treatment may be part of the operation one also requires a pair of forceps for removing specimens from the neoplasm.

The operation is performed as follows:

The patient is cystoscoped in the usual manner. If there is any doubt as to the malignancy of the tumor a section of this is removed by the cystoscopic forceps. Forceps and telescope are then withdrawn so as to permit the bladder to empty itself of the blood which follows the removal of the specimen. The electric wire is then introduced with the telescope and plunged into the depths of the tumor. It is then attached to the source of electricity (see below), the current turned on for an instant, and the patient asked whether he feels any pain. If the electrode is properly placed no pain is felt. If a strong current is used the cystoscope is then turned off so that its lamps may not be burned out. If a mild current is used one may observe it through the cystoscope. As soon as the current is turned on, bubbles begin to appear

[1] *Jour. A. M. A.*, 1910, liv, 1768; also 1912, lix, 1784.

from about the end of the electrode, and the tissues near it become blanched and subsequently black. The electrode is held in place for about thirty seconds, and then moved to another part of the tumor and the operation repeated. The operation is thus continued by repetitious burnings of various portions of the surface of the tumor until the patience of the operator and of the victim is exhausted, or until the tumor has become completely charred over its surface.

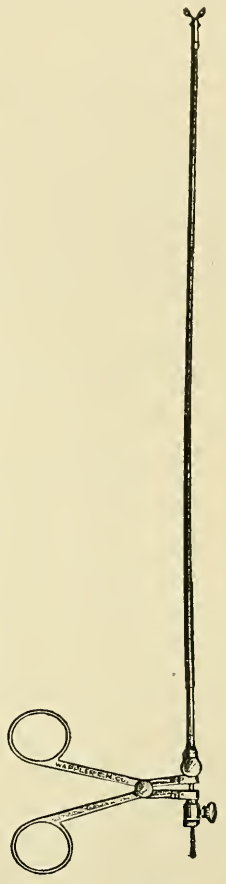

Fig. 181.—Cystoscopic Forceps.

Some operators prefer to try to attack the base of the tumor by slipping under its overhanging fringes and endeavoring to burn its pedicle, thus once for all destroying its blood supply. This technic seems to leave the patient more than usually liable to grave postoperative hemorrhage.

After the operation the patient should rest relatively quiet for twenty-four hours, and then may go about his business. If the bladder becomes irritated the best injections to employ are silver nitrate and argyrol. At about the tenth day sloughs begin to separate and there is likely to be some bleeding. Exceptionally this bleeding is very grave. I have twice had to empty the patient's bladder of clots by the evacuating tube and several deaths have been reported from hemorrhage. For this reason the patient should be within call of an experienced physician for at least two weeks after each operation.[1]

The operation is repeated every two weeks until the tumor has been apparently burned away. No note need be taken of swellings that appear about the base of the tumor, for such a swelling, though it looks exactly like carcinoma, is due to the burning itself.

After the tumor has been apparently destroyed a month is permitted to elapse, then a confirmatory cystoscopy is done. This should be repeated after six months, then after a year, and doubtless thereafter at intervals of three years.

Recurrences are extremely uncommon excepting in the outgrowth of small papillary lesions that had been overlooked at the time the first tumor was treated. Only one relapse *in situ* after an interval of more than one year of apparent health has been reported.[2]

The method is totally unsuited for the treatment of infiltrating

[1] *Trans. Urol. Assn.*, 1915.

[2] Two deaths by rupture of the bladder have been reported.

bladder growths. Multiple papillomata as well as very large papillomata may be removed much more rapidly by suprapubic section and cauterization, to be followed by intravesical injection and treatment when necessary.

THE CYSTOSCOPIC FORCEPS

Young was the first to introduce a cystoscopic forceps for the purpose of removing foreign bodies or specimens from the growths of the bladder. Buerger[1] has further developed this method and devised a very ingenious set of cystoscopic instruments whereby specimens may be removed from doubtful cases of tumor, tuberculosis or other bladder lesions; foreign bodies and even wee stones may be picked up (though stones are extremely elusive); and stricture of the ureter orifice retaining stone or causing intravesical ureteral cyst may be slit.

The cystoscopic lithotrite has, unfortunately, not yet been perfected to a degree permitting its general use.

CYSTOSCOPIC EXTRACTION OF URETER STONES

The passage of ureter stones may be encouraged by prodding them with the ureter catheter, and by injecting the ureter as previously described. If the stone is caught at the very orifice of the ureter, slitting with the urethroscopic scissors may expedite its passage. Small stones may also sometimes be extracted by the cystoscopic alligator forceps. Thus far the efforts made to reach stones higher up the ureter and to extract them by forceps or to encourage their passage by mechanical dilatation of the ureter have proven of little service. Lewis[2] reports a number of cases showing the passage of stone after intraurethral manipulation.

[1] *Med. Rec.*, June 21, 1913.

[2] *Surg., Gyn. & Obstet.*, 1915, xx, 462.

CHAPTER LXXVII

OPERATIONS FOR THE CURE OF URINARY FISTULA

Treatment of fistulae discharging urine, whether they connect with the kidney, the ureter, the bladder, or the urethra, is primarily expectant. *If retention is not present, the fistula will heal, unless there is considerable loss of tissue.* If there is retention, this must, of course, be removed before the reëstablishment of urinary flow through the natural passages can be looked for.

Among the injections employed to encourage healing, the 25 per cent ethereal solution of hydrogen peroxid is generally the most useful; but, if all else fails, operation is required to heal the fistula.

The surgical principle at the bottom of almost all the operations undertaken is the separation of the visceral and cutaneous ends of the fistula, suture of the visceral orifice (or, if the fistula is between two viscera, suture of both visceral orifices), and the interposition between the two ends of the fistulous tract of a thick body of normal tissues after the tract itself has been excised. The treatment of renal fistula forms almost the only exception to this rule.

Tuberculous fistulae may heal spontaneously, though they have existed for months. Beyond curettage, surgery helps them little.

Carcinomatous fistulae do not heal.

RENAL FISTULA

Urinary fistula in the loin, following operation upon the kidney, will always heal unless there is obstruction to the normal urinary outflow, or unless there remains a tuberculous kidney or ureter within the loin. The operations for the relief of these fistulae consist, therefore, in the relief of urethral or renal retention, if these be present, or in the removal of the disorganized kidney or ureter. Previous to operation on non-tuberculous cases an attempt to encourage the closing of the fistula by the prolonged retention of a ureteral catheter should be made if this is practicable.

Removal of ureteral obstructions has already been discussed (p. 701). Nephrectomy of an old pyonephrotic kidney which has long been

fistulous is one of the most difficult and dangerous operations of urinary surgery.

Basing his practice upon the researches of Hermann and Nicolai, Holt [1] has suggested and practiced ligature of the renal pedicle for the

FIG. 182.—TUBERCULOUS FISTULA FOLLOWING NEPHRECTOMY. Since it does not run to the ureter, operation will not benefit this case.

purpose of avoiding the difficulties of this operation. He incises the anterior abdominal wall along the outer edge of the rectus, pushes the large and small intestines toward the median line, and incises the peritoneum over the renal vessels to the outer side of the mesocolon. The retroperitoneal tissues are then separated toward the vertebral column until the renal artery and vein are discovered. If the adhesions are so dense as to make this separation difficult, it may be preferable to incise the posterior peritoneum internal to the colon, and proceed with

[1] *Medical Record,* 1907, June 22.

the ligature of the renal vessels in the space between the colic arteries. The artery and veins are tied separately, and a careful search made to be sure that no accessory renal vessel has been overlooked. The wound is then closed in the usual manner.

I have never had to resort to this operation.

URETERAL FISTULA

If incomplete, treatment should be attempted by the indwelling ureter catheter; if complete, the choice is between reimplantation of the ureter into the bladder, the bowel or the skin, or nephrectomy if the opposite kidney is sound (Furniss [1]).

HYPOGASTRIC VESICAL FISTULA

Hypogastric vesical fistula will usually close if the urethral obstruction is relieved and there is no great loss of tissue. The retained urethral catheter may be of assistance. Even though the fistula remains open for many weeks or opens and closes intermittently, the surgeon should not be too hasty in suggesting operative relief, but should reserve this for cases that have proven absolutely rebellious for months.

The operation should be frankly intraperitoneal. It consists in excision of the fistulous tract, freeing the wall of the bladder, and closure of the fistulous orifice in the bladder wall by mattress sutures, reenforced, if possible, by a layer of Lembert sutures. The abdominal wound may be left open, or the muscles may be caught together over a small drain. The retained urethral catheter should be employed, if possible.

VESICO-INTESTINAL FISTULA

The operation for vesico-intestinal fistula consists in median abdominal section, isolation of the loop of intestine adherent to the bladder (a large ureter catheter placed in the fistula may be of assistance), emptying and clamping of the gut, separation of the gut from the bladder, closure of the gut by enterorrhaphy or anastomosis, and closure of the bladder orifice by mattress suture. The retained urethral catheter and drainage to the point of suture in the bladder are necessary.

VESICOVAGINAL AND VESICO-UTERINE FISTULA

Vaginal Fistula.—The patient is placed in the lithotomy position and the vaginal orifice of the fistula exposed and liberated by a circular

[1] *Am. Jour. of Obstet.*, 1915, lxxxii, No. 5.

incision. This incision is carried up about the fistula until the mucous membrane has been freed up to the bladder. The fistula is then turned inside out, as it were, into the bladder and caught by one or two submucous sutures. The vesicovaginal septum is then sutured with chromic gut, and afterward the vaginal wall sutured over all with simple catgut.

The bladder should be drained by a retained catheter.

Vesico-uterine Fistula.—The closure of vesico-uterine fistula is extremely difficult. The operation of choice is total hysterectomy with suture of the bladder wall in layers. Exceptionally the fistula enters the lower part of the cervix and can be cured by excision of the fistulous tract and suture of the bladder in layers.

URETHRORECTAL FISTULA

The treatment of urethrorectal fistulae depends largely upon the size of the opening in the rectum. If this is so small that it can only be felt as a dimple, the pockets of granulation tissue and pus between the rectum and the bowels should be opened by a median or bilateral perineal incision, the fistulous tract carefully curetted throughout and all pockets freely opened into the main channel leading to the perineum, care being taken not to enlarge the actual opening in the mucosa of the rectum. A perineal tube is then left in place for about a week. On its removal a urethral catheter is inserted and left in place. In the course of three weeks the rectal fistula should be healed and the urinary fistula down to a granulating point.

This operation is the more likely to succeed if suprapubic drainage is employed to divert the stream of urine.

If the hole into the rectum is half a centimeter or so in diameter the above operation will fail. The treatment then depends upon whether the patient is greatly inconvenienced by his fistula, notably whether it tends to pocket and burrow, and also whether it communicates with the perineum.

Such patients often arrive at the hospital in a deplorable condition with a perineum full of irregular pocketing sinuses. The first operation should then simply be a house-cleaning one, consisting of incision and curetting with the object of reducing the sinuses to a single central straight fistulous tract.

Though the resultant fistula be relatively small it is imbedded in such a mass of scar tissue that, unless it causes the patient grave inconvenience, it is often wise not to attempt any further operation. Most of the procedures that have been suggested for the treatment of these conditions only leave the patient in a worse state than he was in before.

Young and Stone [1] report the cure of three complicated cases by the operation of Tedenat. This begins with the establishment of a suprapubic fistula; then the anus is circumscribed by an incision dividing the mucosa at the mucocutaneous margin, and extending anteriorly along the median line of the perineum, thus having a racquette shape. The mucous membrane of the bowel is freed as in the Whitehead operation high enough to permit the orifice of the fistula to appear outside of the anus. This loosening is assisted by deepening the "handle" of the racquette-shaped incision in the midline of the perineum in front, and division of the fistula between the rectum and the urethra. The urethral end of the fistula thus laid bare is then carefully sutured and healthy tissues brought from side to side to protect it. Four stay sutures of chromic gut are then taken in the rectum to hold it down, the excess including the rectal orifice of the fistula cut away, the rectal edge sewed to the skin after the sphincter muscle and the levatores have been pulled together in front by stout chromic gut sutures in order to reconstruct the perineum.

If the above operation is impossible, the fistula may be changed into a urethroperineal one by Albarran's procedure of freeing the rectum by a posterior, U-shaped incision carried up to beyond the point of fistula. Lateral incisions are then made in the rectal wall and carried forward to meet in a V above the fistulous orifice on the anterior wall of the rectum. The two edges of this V are then united so as to leave a urethral channel running to the perineum. The posterior edges of the V are also then united, thus isolating the rectum from the new urethroperineal fistula. After healing has taken place, the urethroperineal fistula is closed by a secondary operation.

URETHROPERINEAL FISTULA

Perineal urethral fistulae will almost always close, unless they are tuberculous or cancerous, by the lapse of time, if the caliber of the urethra is kept open by sounds, and the fistula repeatedly curetted. If these means fail, the fistula may be closed by free dissection of the perineum, excision of the scar, and suture of the urethra, over which is drawn a thick layer of the urethral and perineal muscles. The urine should be diverted through a urinary fistula.

PENILE FISTULA

The pinpoint fistula that results from suppuration of a urethral gland rupturing into the frenum of the prepuce should never be operated

[1] *Trans. Am. Assn. of G.-U. Surgeons*, 1913, viii, 270.

upon. It may almost always be cured by injections of 25 per cent ethereal solution of peroxid of hydrogen into the inner orifice of the fistulae after the surrounding parts have been protected by vaselin. Operation almost inevitably leaves a larger hole than was there before.

Other penile fistulae also usually do much better under expectant treatment by opening abscesses, curetting the fistula, passing sounds, and awaiting healing, than they do under any plastic operation.

The great source of failure in attempted plastic operations upon the penis is the absence of blood supply in the flaps and the presence of urine. A suprapubic or perineal fistulization of the bladder should therefore be a preliminary to every operation, and the flaps should be made in such a way as to have the greatest possible vitality. I have succeeded once or twice in closing relatively small fistulae by turning them inside out by means of a needle sutured to the skin end of the fistula after it had been dissected as free as possible, which needle was then pushed, blunt end first, into the urethra and out of the meatus, inverting the fistula in behind it. The peri-urethral tissues are then sutured.

CHAPTER LXXVIII

OPERATIONS FOR MALFORMATIONS OF THE URETHRA AND BLADDER

MEATOTOMY

Antisepsis.—The tip of the penis should be well cleansed with soap and water and bichlorid, and the terminal portions of the anterior urethra irrigated with a 1: 5,000 solution of the latter.

Anesthesia.—A minute bunch of cocain crystals, or a fragment of a cocain tablet is inserted within the meatus and dissolved by instilling upon this, with a medicine dropper, a few drops of 1: 1,000 adrenalin solution.

Anesthesia is completed within five minutes, by which time a distinct blanching of the tip of the penis is noticed.

The Operation.—A blunt-pointed, straight bistoury is introduced into the urethra, the floor of which is cut by an outward sweep of the instrument. With the bulbous bougie the patency of the canal is then tested, and any bands that require further division are cut. If the meatus internus is narrow, this may be cut with the bistoury, although some surgeons prefer to use the urethrotome for this purpose. All incisions should be made upon the floor of the canal.

OPERATION FOR RUPTURE OF THE URETHRA

When the urethra is ruptured in its penile portion, the indwelling catheter will usually prevent complications, though if large hematoma occurs this should be incised, and through this incision the urethral walls may be sutured. For perineal rupture, immediate median perineal section should be performed. If a slight, or partial, rupture is encountered, clots are cleared away and a perineal tube inserted.

If the rupture is complete, retrograde catheterization identifies the posterior segment of the urethra and leaves a suprapubic wound for derivation of the urine.

If there is too much loss of tissue to permit suture of the urethra, no plastic operation should be attempted, but an indwelling catheter is inserted, which is introduced into the meatus and out through the

perineal wound, then in from the perineal wound and into the bladder. If fistula persists this requires secondary operation.

OPERATIONS FOR HYPOSPADIAS

Beck's Operation.—This consists in liberating the urethra, bringing it forward and suturing it to an orifice punched through the glans. The urethra must be freed well back and sutured to the apex of the glans to prevent incurvation (Figs. 183, 184, 185). This operation is ap-

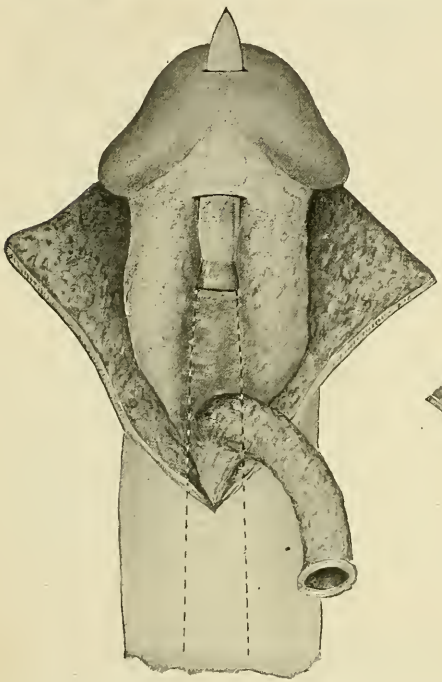

FIG. 183.—BECK'S OPERATION FOR BALANITIC HYPOSPADIAS. Liberation of the urethra—puncture of the glans.

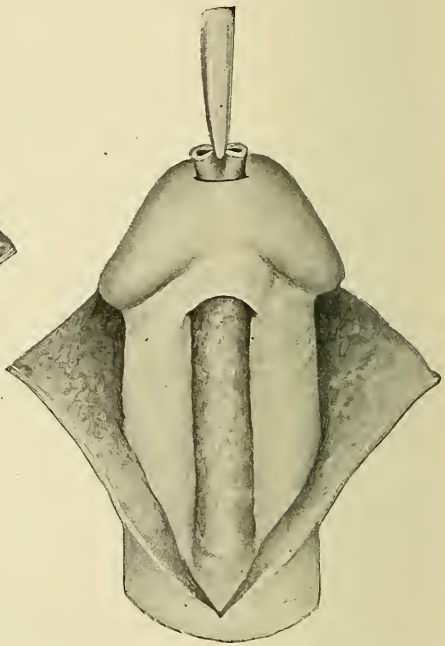

FIG. 184.—BECK'S OPERATION FOR BALANITIC HYPOSPADIAS. The urethra drawn through the glans.

plicable only to balanitic hypospadias and to a penis without any congenital incurvation.

Operation for Penile Hypospadias.—For *penile hypospadias* the operations are many and various. Certain preliminary steps are necessary in almost all cases.

First, *the penis must be freed from its scrotal adhesions.* If these are slight, a transverse incision through the penoscrotal frenum will, when sutured in a longitudinal direction, suffice to free the organ. But if the penis is deeply buried in the scrotum the integument of the former must be derived from the latter with regard only to covering in the

penis; the scrotum will, by virtue of its looseness, adapt itself to the loss of almost any amount of skin.

Secondly, the *incurvation of the body of the penis often demands attention.* This may be corrected through the liberating incision. A transverse incision is carefully made through the whole thickness of the sheath of the corpora cavernosa on its under surface, care being taken to avoid the erectile tissue. This is usually sufficient to permit straightening the penis. If not, the intercavernous septum may require division down to the dorsum. Then the penis is forcibly straightened and snugly bandaged about a slight splint in an overextended position to prevent recontracture. I can vouch from personal experience for the satisfactory results obtainable by this somewhat violent procedure.

Fig. 185.—Beck's Operation for Balanitic Hypospadias. Suture.

Finally, comes the most delicate part of the treatment—the extension, namely, of the urethra to its proper length. Great ingenuity has been displayed in the formation of the new canal. The operations of Duplay, Thiersch, Dieffenbach, Dolbeau, Laurent, and Van Hook [1] deserve mention. In each of these the lining membrane of the new canal is derived, in one way or another, by flaps turned in from the adjoining regions. That each has been devised to supplement the older ones is an evidence—to which the surgeon who has tried any will certainly testify—of how rarely they succeed and how utterly baffling the condition is.

Mayo's Operation.—The prepuce is extended as for circumcision and two incisions are made about one inch apart extending from its free border to its attachment. The prepuce is unfolded, forming a loop of thin skin about two and one-half inches in length. Should this not be considered sufficient to reach from its attachment to the hypospadic opening, the two incisions are extended back along the dorsum of the penis until sufficient tissue is obtained, when the two incisions are connected by a transverse one and the flap of skin lifted but left attached to the penis at its base. Several sutures now close the lateral integument of the penis over the dorsal area.

The pedunculated flap of prepuce is constructed into a tube with its skin or inner surface inside, by means of a number of catgut sutures. The penis is tunnelled by means of a sharp bistoury or trocar and cannula through the glans, above its groove, along the penis to a point beneath the hypospadias opening, when it is made to emerge at one side of, but close to, the urethra. The tube of prepuce is drawn through the tunnel and sutured where it enters the glans and also where it emerges.

[1] Cf. Mayo, *Jour. Am. Med. Assn.*, 1901, xxxvi, 1157.

Ten days later the new urethra is cut free from the remains of the prepuce.

Six months or a year later the urine is diverted through a perineal

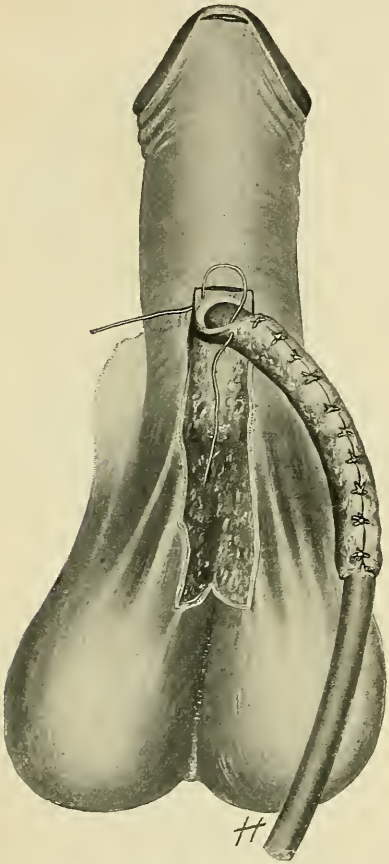

Fig. 186.—Rochet's Modified Nové-Josserand Operation for Hypospadias. The flaps are cut, the catheter introduced, the scrotal flap sutured around it.

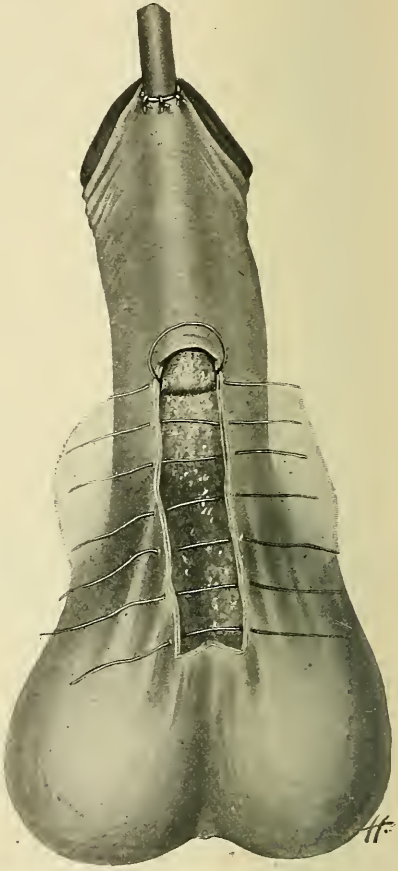

Fig. 187.—Rochet's Modified Nové-Josserand Operation for Hypospadias. The final sutures.

or suprapubic fistula and the adjoining orifices of the old and new urethrae united.

I have employed with one complete success and one partial failure, the Rochet-Nové-Josserand operation, which avoids many of the difficulties encountered in other procedures.

Nové-Josserand's Operation.—Through a transverse incision 2 cm. long and just in front of the hypospadic meatus, a stout probe is introduced and passed forward along the under surface of the penis, in the subcutaneous connective tissue, until it reaches the base of the glans,

elevating the skin from the entire under surface of the penis. The anterior orifice of the canal is then formed by slitting up the under surface of the glans, or by puncturing it with a trocar. To obtain an epithelial lining for this canal—and herein consists the originality of the operation—an Ollier[1] skin-graft, 4 cm. wide and considerably longer than the intended canal, is taken from the inner side of the thigh, where there are no hairs, and wrapped, inside out, around a woven catheter, 21 French in size, and held in place by a ligature at each end and one or two sutures, all of 00 catgut. (Rochet[2] employs, instead of the Ollier graft, a flap taken from the scrotum, with its base at the abnormal urethral orifice. This device eliminates the fistula between the old urethra and the new (Figs. 186, 187).) The catheter thus covered is then inserted into the canal, and when the graft is in place the anterior ligature is cut and removed, and the edge of the graft sutured to the glans penis. The catheter is then cut off short so that each end barely protrudes from the canal, and a snug dressing is applied with the penis held in the erect position. A retained catheter is used to draw off the urine. (In the Rochet operation the catheter around which the graft is wrapped is used as a retained catheter.) On the eighth day the posterior ligature is cut and the catheter removed. Five days later the daily passage of sounds is begun and continued for three weeks.

The Nové-Josserand operation has been still further modified by its originator,[3] as follows:

As a first step, three operative procedures are performed:

1. The incurvation is corrected by incision of the fibrous envelopes of the corpora cavernosa.

2. The bulbous urethra is incised for a distance of at least 4 cm. and sutured to the skin of the perineum, thus forming a perineal urethrostomy.

3. The edges of the hypospadic meatus are incised and sutured to each other, so as to close its orifice permanently.

Six or eight weeks later the second operation is performed, as follows:

1. The meatus is reopened by a simple longitudinal incision.

2. By means of a trocar a canal is bored in the subcutaneous tissues of the penis from the hypospadic meatus to the glans penis. This canal is sufficiently dilated to admit a No. 20 French sound. It is then compressed for a few moments in order to check the bleeding.

[1] The Ollier graft differs from the Thiersch graft in that it is made as thick as possible without including any of the subcutaneous tissue, instead of—as in the Thiersch method—as thin as possible.

[2] *Guyon's Annales*, 1900, xviii, 648.

[3] *Arch. gen. de Chir.*, 1909, No. 25.
See also *Jour d'Urol.*, 1914, v, 393.

3. A graft consisting of the whole thickness of the true skin, half again as long as the new urethra and about 4 cm. wide, is taken from the antero-external surface of the thigh. This is sutured, skin side inward, about a soft-rubber catheter, size 18 French. Three fine catgut sutures are employed.

4. A fine dressing forceps is introduced from before backward through the newly tunneled canal and withdrawn, carrying the catheter and graft with it. The graft should extend well beyond each end of the new canal. The catheter is fixed in place by a silk suture attaching it to the glans.

On the eighth day a silk suture is tied to the end of the catheter and this is gently withdrawn, carrying the silk suture into the new canal, where it is left.

Thereafter the new canal is gently irrigated once a day with boric acid solution.

On the fourth day after removal of the catheter, the silk suture is tied to the tip of a No. 12 French bougie, which is thus gently drawn through the new canal and withdrawn again, leaving the silk thread still in place. This sounding is repeated with instruments no larger than No. 15 French twice a week for two months, the silk suture being employed as a guide the first three or four times. Thereafter dilatation is carried up to No. 20 French, and if there is any difficulty in this operation the canal is widened by urethrotomy upon the roof. About two months more are required to obtain a canal of sufficient caliber, and during this time the fistula at the junction of the new and old urethras may be expected to close. When this has occurred, the perineal fistula is closed by a third operation. The mucous membrane of the urethra is cut away from its attachment to the skin and freely separated from the intervening tissues. The urethra itself is sutured and the soft parts sutured over it, the skin wound being left open.

OPERATIONS FOR EPISPADIAS

The cure of epispadias requires two operations:

1. Closure of the sphincter.

2. Formation of a new canal.

The Sphincter.—Trendelenburg states that the sphincter may be adequately tightened by excision of a broad wedge-shaped piece of the orifice and suture.

Formation of a New Canal.—This may be done by a flap operation or by the Nové-Josserand procedure.

OPERATIONS FOR EXSTROPHY

Three varieties of operation may be recognized:

1. Obliteration of the bladder.

2. The formation of a new bladder.

3. Diversion of the stream of urine.

With each of these the radical cure of hernia may be combined.

1. Obliteration of the Bladder (Sonnenberg[1]).—This operation attempts but little. The mucous membrane of the bladder, or the whole bladder wall, is removed, and some attempt is made by skin-grafting or flap-raising to bring the abdominal wall together and so to remove the large raw surface of the bladder and to substitute scar or skin in its place. The ureters, with the mucous membrane around their orifices, are displaced downward and sutured to the end of the penile groove, which may be closed previously or simultaneously by one of the operations for epispadias. Thus the object of the operation is to improve the patient's condition to the extent of leaving him with a manageable incontinence by removing the sore and stinking bladder. The operation is singularly unsuccessful.

2. The Formation of a New Bladder (Autoplastic Method).—This operation is the ideal one, but it is an ideal that has not been realized in practice. Until some one shall produce a sphincter for the bladder the patient's capacity to hold his urine after operation will be nil.

The operations may be described as:

a. Suture of the bladder itself.

b. The flap operation.

c. Closing the symphysis.

As a preliminary to operation, hexamethylenamin should be administered to keep the urine sweet, and ureteral catheters should be introduced to keep the wound dry.

The ideal method theoretically is to dissect up the bladder wall, to turn it over, and to suture it so as practically to form a new bladder. There are two causes of failure. In the first place the bladder is so contracted that there is scarcely any tissue to work on. Pousson,[2] in order to overcome this, boldly enters the peritoneal cavity, inverting the bladder, peritoneal coat and all, and then closing off the general peritoneal cavity (but he reports only one case, and that a failure). In the second

[1] *Berlin. klin. Wochenschr.*, 1882, xix, 471.

[2] *Guyon's Annales*, 1898, xvi, 1223.

place, in spite of ureteral catheters and constant changes of dressings, urine gets into the wound, which granulates instead of healing, with the result that the sutures tear out.

The flap operation has been developed by the ingenuity of Roux, Thiersch, Pancoast, Ayres, Holmes, and many others. (Cf. Pousson.) One or two flaps taken from the surrounding skin are turned in to form the anterior wall of the bladder, and the raw surface thus left is covered in as far as possible by other flaps. This operation often succeeds after many partial failures, but the hairs that ultimately grow from the inverted skin become incrusted with phosphates, and the patient finds his partial relief not worth the having. Recent experimenters have suggested filling in the gap with a segment of the gut (Tizzoni and Poggi, Enderlin[1]), and this operation has been performed once successfully on a man by Rutkowski,[2] whose patient, eight weeks after operation, could retain 25 c.c. of urine. The defect in the bladder wall in this case was not a large one. The gut used was the ileum, which was left attached to its mesentery. Manifestly such an operation is not without its dangers both immediate and remote.

Attempts at closing the symphysis in order to diminish the gap to be covered over, and at the same time to attempt the formation of a sphincter, have not been successful. Trendelenburg applies a belt, hoping by its pressure to approximate the bones, and if this fails he opens the sacro-iliac synchondrosis on each side. This operation is not applicable to children over eight years of age, and its results have been quite universally unsatisfactory, though Delagénière reports a case in which, after seven supplementary operations, he obtained a radical cure and a satisfactory sphincter. Berg has employed osteotomy of both iliac bones. Not enough work has been done along any of these osteoplastic lines for broad conclusions to be laid down as to their results.

3. Diversion of the Stream of Urine, by means of ureteral implantation into the loin or the bowel, is a confession of failure; but almost the only hope of success (p. 707).

[1] *Deutsche Zeitschr. f. Chir.*, 1900, lv, 50.

[2] *Centralbl. f. Chir.*, 1899, xxvi, 473.

CHAPTER LXXIX

OPERATIONS UPON THE SCROTUM AND ITS CONTENTS

Antiseptic Preparation.—The skin of the scrotum is so sensitive that preoperative cleansing must practically be confined to a soap and water washing a few hours before operation. This should be repeated when the patient is on the table and the scrotum flushed finally with 50 per cent alcohol. Tincture of iodin is totally unreliable as an antiseptic because it does not reach well into the crevices of the corrugated skin.

Local Anesthesia.—All the operations upon the scrotum may be performed under local anesthesia, but I prefer not to employ this except for conditions exclusively confined to the scrotum and not involving any considerable inflammation.

The spermatic cord must first be anesthetized within the inguinal canal. If the external ring is large, the finger may be introduced into this and the hypodermic needle thrust first through the skin, then through the external oblique and then into the tissues of the cord where some 30 c.c. of 0.25 per cent solution of novocain is injected. If the finger cannot be introduced into the external ring, the accuracy of the procedure depends upon the surgeon's sense of touch, which will tell him when his needle pierces the external oblique over the inguinal canal. While awaiting the action of this anesthesia, the skin of the scrotum over the line of projected incision is infiltrated.

Postoperative Dressing.—In spite of the most careful hemostasis considerable edema will occur in the scrotum after operation, just as it would about the eyelid, unless some pressure is provided. It is for this reason that the operative incision is usually made in the groin, and for minor operations not involving much dissection the bandage described for the treatment of acute epididymitis is quite sufficient pressure and support (if one remembers not to stuff it too full of gauze).

For the more extensive operations involving considerable dissection an adhesive plaster dressing should be applied, the bandage being made of strips about two inches wide extending alternately in each groin from the perineum below to the abdomen above; each bandage overlapping the last, beginning at the median line. Provision is made for the penis to protrude and several strips across the abdomen hold the bandage down. It can further be supported by a gauze bandage

over all. Such strapping, if it includes very little gauze over the incision, makes a very snug dressing.

OPERATIONS UPON THE SCROTUM

Inflammatory, fistulous, and gangrenous affections of the scrotum require bold, free incision and excision. The surgeon should not have any misgivings as to the length or variety of his incisions, since these close with incredible rapidity. Even though the testicles are laid entirely bare by excision of gangrenous areas of skin, secondary skin-grafting is rarely necessary.

Resection of the uninflamed scrotum, which may be required for cosmetic purposes after the removal of large tumors, hydroceles, or varicoceles, is, generally speaking, best performed by transverse excision of the skin. The redundant portions of the scrotum are caught with a long, curved intestinal clamp, and the skin protruding below the clamp cut away. The incision may then be closed by suture before removal of the clamp, though hemostasis is more likely to be effectively accomplished if the clamp is first removed, the bleeding points in the fascia caught and tied, and the skin then sutured.

VASOTOMY

The vas deferens is identified by grasping the tissues of the spermatic cord between the thumb and index finger and permitting them to slip to and fro from the grasp until the thick, cordlike vas is distinctly appreciated. This is usually to the inner side of most of the other structures. The scrotum is then thrown forward and the vas readily brought under the skin posteriorly. The point at which the vas shall be most readily accessible having thus been identified, it is dropped and this point is anesthetized by infiltration for about 2 cm. The vas is then brought back under the infiltrated area and pressed against it. The skin and underlying tissues are divided and the vas brought into the wound, where it may be tied or opened, or a piece of it excised. The small skin-wound is then closed by suture, care being taken to include all bleeding points.

Belfield's operation for drainage of the vas deferens and irrigation of its ampulla is performed in a similar manner; but when the vas is divided a fine silk suture is passed into the wall and out through the lumen of the upper segment, then in from the lumen and out through the wall of the lower segment. This suture is tied loosely, and after the irrigations have been performed to the satisfaction of the operator, it

is tied tightly in the hope that the vas may reunite patent. Such reunion would seem improbable, yet it has been verified in several cases. The "unilateral sterility" which is likely to result from this operation is its chief objection.

OPERATIONS FOR VARICOCELE

Subcutaneous Ligation.—The surgeon grasps the scrotum with the thumb and index finger of his left hand. By drawing the fingers slowly toward the patient's right side the spermatic cord is allowed to slip piecemeal from the grasp. First the flabby veins of the plexus slip through in a wormlike bundle, then, after a slight interval, the solitary thick vas, followed perhaps by one or two more veins. This maneuver is repeated once or twice until the surgeon is absolutely sure that he has identified the interval between the vas and the plexus. Then, holding the veins well to the outer side, and pinching the scrotum tightly to be sure that no veins elude his grasp, a needle threaded with a long strand of *braided silk,* so stout that the surgeon *cannot break* it, is plunged into the anesthetized area close to the tip of the thumb. If the skin in front and behind has been anesthetized this maneuver is quite painless. When the needle emerges from the back of the scrotum *one end* of the silk is pulled through and out of the scrotum posteriorly.

The veins are then permitted to drop away, the needle reinserted through the posterior puncture, passed forward between veins and dartos externally, and drawn out through the original anterior puncture.[1]

A little piece of dartos will always be included in the silk at the point of posterior puncture. This is torn away by pulling the scrotum backward while making strong traction upon the loop of silk. The veins are thus caught in a loop of silk, which is tied firmly and tightly in a triple knot. The ends are cut short and the knot permitted to recede into the scrotum. A drop of collodion upon each puncture completes the operation.

This single ligature suffices for most cases. I also often tie the veins just above and, exceptionally, below the testis, and, in a few cases, I have applied the ligature to dilated veins on the inner as well as on the outer side of the vas. I have never introduced more than three ligatures in any one case. The veins below the testicle are especially hard to separate from that gland.

For *after-treatment* the patient is kept in bed with the testicle supported for forty-eight hours. The pain is insignificant and may be

[1] This technic is simpler than that involving the use of the Reverdin needle, as originally proposed by my father.

soothed by a hot-water bag. A certain amount of edema persists for a month, during which time perfect comfort is insured by a suspensory bandage. After this edema disappears the ligature may be distinctly felt, and usually remains unabsorbed for years. I have found it in place six and seven years after the operation. Rarely the ligature works its way out at the end of several months. This does not incapacitate the patient, since it is accompanied by no active suppuration.

To insure the success of this little operation several points must be insisted upon:

1. Cleanliness, to prevent suppuration.
2. Careful exclusion of the vas deferens from the ligatures.
3. Careful inclusion of all the varicose veins. If all are not included the varicocele may not be cured, or a vein may be punctured.
4. Tying the first knot tightly. If the first knot is not tied with all the surgeon's strength he cannot feel assured that all the veins are obliterated.
5. The use of very heavy silk.

If precautions 3, 4, and 5 are observed there can be no recurrence so long as nonabsorbable ligatures are employed. With catgut relapse is certain, with silk practically impossible.

The Open Operation.—It is best to make the incision where the scrotum joins the groin, so that the veins are exposed just below the external inguinal ring. By operating in this region the danger of scrotal hematoma is materially lessened and the veins are encountered above their point of varicosity and tortuosity and can be conveniently handled. The vas, with its accompanying vessels, is separated from the bundle of veins and drawn to one side. The veins are then divided between two ligatures, or else the bundle of veins is drawn up out of the scrotum, an inch or so excised between ligatures, and the ends of the ligatures left long and tied together. By this means the cord is shortened and the testicle hoisted to its proper position alongside of its partner. Oozing is then checked and the wound closed.

Resection of the Scrotum.—This operation is described on p. 776.

The distensible scrotal skin cannot be depended upon to support the testicle so as to cure varicocele, and therefore I see no purpose in reefing the scrotum, except to remove redundant tissue. To elevate the testicle the veins must be shortened.

OPERATIONS FOR HYDROCELE

Tapping.—This requires no anesthetic. The skin is made tense, and a trocar or large needle plunged into the anterior part of the tumor, a little below the center. The testicle is thus avoided (Fig. 1885).

If the testicle is wounded, the patient complains of some pain and the serum withdrawn is bloody. This accident results in immediate refilling of the hydrocele with blood; but no other complication need be feared. If several months elapse before the hydrocele is tapped again, the fluid will usually be found limpid and straw-colored, the blood pigment having been resorbed.

Injection.—The only instruments required are an aspirator with a large needle, a hypodermic syringe and needle, and some pure carbolic acid.[1]

The hypodermic needle, detached from its syringe, is first plunged into the anterior surface of the hydrocele and watched until the appearance of a drop of serum announces that its point is within the cavity. Then the aspirating needle is introduced and the fluid exhausted, *if possible, to the last drop,* since every drop of serum remaining dilutes the acid to be injected. (Relapses are said to be less common if one irrigates the cavity with salt solution.[2])

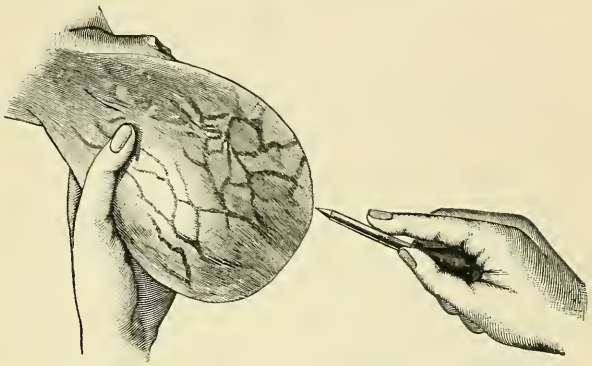

FIG. 188.—TAPPING FOR HYDROCELE. (Bryant.)

Meanwhile, the hypodermic needle has not been disturbed. It is now screwed to its syringe, filled with pure carbolic acid, and 0.5 to 1.5 c.c. (5 to 20 minims) injected into the sac. This is smartly rubbed for a moment, and the skin douched with alcohol if any acid has touched it.

The subsequent pain is momentary. The operation requires no anesthetic.

The patient usually prefers to remain in bed for one or two days after the operation, though this is not necessary. For a week or ten days the sac gradually refills. Then it should begin to grow smaller. If it is excessively large at the end of a week, or if marked resorption is not apparent in ten to fourteen days, a secondary aspiration should be performed without injection.

The advantages of injection over any form of incision are manifest if only success may be anticipated. The failures so frequently reported are due to three causes—viz.:

[1] I employ the crystals, deliquesced by heat.

[2] Herbst, *Jour. A. M. A.*, 1914, lxiii, 2219.

1. Application of injection to cases incurable by this method—i. e.:
   a. Most symptomatic hydroceles.
   b. Spermatoceles, hematoceles and chyloceles.
   c. Hydroceles with inflamed, indurated, or calcareous walls.
   d. Hydroceles containing more than 150 c.c. (5 ounces).
2. Errors of technic, notably:
   a. Incomplete evacuation. This is the most frequent cause of failure. To insure success the last drop must be squeezed from the vaginalis.
   b. Injection of the carbolic acid into the cellular tissue. One need scarcely insist upon this point.
   c. Failure to perform the secondary aspiration, which is sometimes part of the cure.
3. The use of iodin instead of carbolic acid. The iodin injection is painful and uncertain, while the carbolic acid, being a local anesthetic, produces only a momentary tingling and, at my hands, has been a certain cure.

Incision (*Volkmann's Operation*).—The sac is incised and its cut edges sutured to the skin. The surface of the sac is swabbed with pure carbolic acid and drained. The healing of the wound requires an interminable time, and the operation has been dropped in favor of—

Excision (*Bergmann's Operation*).—The skin and fascia are divided down to the surface of the tunica vaginalis and dissected back from it. The sac is then opened, its contents allowed to drain away and the entire parietal layer snipped off. Complete dissection of the parietal layer is a tedious procedure, and yet recurrence has followed the operation on account of inattention to this detail. A simpler operation, therefore, is—

Eversion of the Sac (*Winckelman's Operation*).—The sac is bared and opened as in Bergmann's operation, and all the parietal layer of the vaginalis that can be readily freed is excised. The testicle is then completely extruded from the scrotum, and the tunica, thus turned inside out, is held so by a few sutures passed behind the testis. The cavity of the vaginalis having thus been obliterated beyond peradventure, the testicle is replaced and the wound closed. Unless traumatic orchitis ensues the cure should be complete within ten days.

Andrews's modification of this procedure consists in making a small incision at the top of the sac and turning the testis out through this, leaving the sac inside out. It does not give quite as satisfactory results.[1]

Operations for Unusual Hydroceles.—In operating upon infantile hydroceles, bilocular hydroceles, and hydroceles of the cord, each case must be dealt with according to its merits, by resection, inversion, or injection.

[1] Lyle, *Surg., Gynec. and Obstet.*, Dec., 1912, p. 733.

EXCISION OF SPERMATOCELE

The sac is brought out through a longitudinal incision in the scrotum, and, if small, excised entire; if large, it must be incised, its contents evacuated, and its wall carefully removed. If any portion of the cyst wall is permitted to remain, the spermatocele is likely to recur. At the point of implantation of the epididymis, the cyst wall may have to be destroyed by a small point of cauterization.

EPIDIDYMOTOMY

The technic to be followed is that of Hagner. General anesthesia is practically always necessary. I have only once operated without.

At the juncture of the swollen epididymis and testicle, an incision 6 cm. to 10 cm. in length, depending upon the amount of enlargement, is made through the scrotum down to the tunica vaginalis, which is opened at the juncture of the epididymis and testicle. After the serous membrane is opened, all the fluid is evacuated and the enlarged epididymis examined through the wound. The testicle, with its adnexa, is delivered from the tunica vaginalis and enveloped in warm towels. The epididymis is then examined and multiple punctures made through its fibrous covering with a tenotome, especially over those portions where the enlargement and thickening are greatest. The knife is carried deep enough to penetrate the thickened fibrous capsule and enter the infiltrated connective tissue. When the knife is through the thickened covering of the epididymis, a very marked lessening of resistance will be felt. If pus be seen to escape from any of the punctures, the opening is enlarged and a small probe inserted in the direction from which the pus flows. By this method, I believe there is less danger of injuring the tubes of the epididymis than by cutting with the knife. After the probe is passed in, pus will be evacuated by light massage in the region of the abscess, and a fine-pointed syringe is used to wash out the cavity with 1 : 1,000 bichlorid of mercury, followed by physiological salt solution. The testicle is then restored to its normal position, and in every case the tunica vaginalis is thoroughly washed with 1 : 1,000 bichlorid, followed by normal salt solution. The incision of the tunica vaginalis is lightly closed with a running catgut suture; a cigarette drain of gauze is then laid over the incision, the skin being brought together with a subcutaneous silver wire suture, the cigarette drain passing out at the lower angle of the wound (Hagner).

The drain is removed on the second day and the patient kept in bed for from three to five days thereafter.

If the abscess in the epididymis is large, it may be opened by a simple puncture through the adherent skin, but, unless fluctuation can be distinctly felt, it is difficult, by this blind operation, to strike the central suppurating point.

EPIDIDYMOVASOSTOMY

Anastomosis of the vas deferens to the epididymis is described as follows by its author, Dr. Edward Martin:

Before the operation is undertaken, strictures, posturethral lesions, and chronic inflammation of the seminal vesicles and vas should be cured. The patency of the vas from the epididymis to the prostatic urethra should be assured by an injection into the lumen of the vas of a watery emulsion of inert pigment which, when passed with the urine or expressed by massage of the vasal ampulla, readily may be recognized. This preliminary operation may be accomplished under local anesthesia by means of either an ordinary hypodermic syringe, the needle of which is blunt, or the syringe used by oculists for washing out the lacrymal duct. The vas is held just beneath the skin by the fingers of an assistant; the line of incision is infiltrated; the vas is exposed, slit longitudinally, and from 20 to 30 drops of the injection are driven in. A large injection is likely to occasion severe pain at the base of the bladder (Belfield). If the pigment does not appear either in the urine, in the seminal discharge, or as the result of massage, anastomosis between the vas and epididymis will be futile.

I believe it better to cut the vas obliquely, split it upward for a quarter of an inch and sew this wide-stretched lumen to the opening made, either in the epididymis, or, if spermatozoa are not found there, in the testicle. The microscopist should be at hand who examines the fluid which exudes from the epididymis when it is opened. This opening is made by the pinching up of a very small portion of it in a pair of conjunctival rat-toothed forceps and snipping this portion off by a pair of eye scissors curved on the flat. Usually a little blood and yellowish fluid will exude. This, taken up on a cover glass, will show innumerable spermatozoa. If spermatozoa are not present, other openings must be made into the epididymis or testicle until spermatozoa are found. The anastomosis between the cut ends of the vas and epididymis may be made by means of four sutures carried by fine curved eye-needles. Either silk or fine silver wires answer well. The suture is carried from without into the wall of the vas, and from within out of the wall of the epididymis. The tying down of the sutures completes the anastomosis. The approach to the epididymis and vas is made through the posterior scrotal wall. It usually does not require the application of a single ligature. The veins should be carefully avoided; otherwise troublesome and painful thrombosis will develop.

Bernart,[1] having had several failures by the above technic, had eight successive successes as a result of introducing a silver wire into the lumen of the vas, bending it -∩-shape into the incision in the epididymis, and carrying its extremity out through the skin incision. He withdraws the wire after twenty-four hours.

[1] *N. Y. Med. Jour.*, Oct. 23, 1915.

EPIDIDYMECTOMY

The skin incision in the scrotum after circumscribing any fistulae that may exist is carried up over the anterior surface of the testicle and the tunica vaginalis opened. This will be found full of fluid or adherent. The outline of the epididymis is studied, the testicle palpated for masses of inflammation in this. If any considerable portion of the testicle is invaded it may seem wiser to perform orchidectomy.

The one delicate point in the operation is the avoidance of the vascular supply of the testicle which passes close to the *inner* side of the epididymis and may be involved in the infiltration about the globus major. Therefore in removing the epididymis one keeps very close to its inner side, especially near its head. The artery of the vas is inevitably divided. If necessary, part of the tunica albuginea is cut away with the epididymis and subsequently sutured with fine chromic gut. Doubtful indurated lesions in the testicle may be neglected. Even if they are tuberculous this will take care of itself. After the whole epididymis has been freed with the adjoining portions of the vas this duct is cut and clamped and freed up into the upper part of the scrotum.

Cabot's technic is probably the most satisfactory for disposing of the vas. He passes the clamp on the lower end of the vas up into the inguinal canal until it reaches the region of the internal inguinal ring; there it is pushed upward and outward and the skin and superficial tissues incised over it. The vas is then picked up and, by means of a finger, inserted into the inguinal canal, freed into the pelvis as far as possible, where it is clamped, divided, cauterized with carbolic acid and dropped back. The groin wound is closed tight, the scrotal wound is drained, and an adhesive plaster bandage applied.

ORCHIDECTOMY

Removal of the testicle is one of the simplest operations in the scrotum. It may almost always be performed under local anesthesia, and through an incision at the junction of the scrotum and groin. The operation is begun as though for varicocele, the spermatic cords picked up, the vein and the vas ligatured separately, the testicle pulled out of its fascial bed in the scrotum, freed by a few strokes of the finger, its gubernaculum tied off, and the testicle removed. It is wise to insert a small counterdrain of rubber tissue at the bottom of the scrotum.

For Tuberculosis.—The vas should be treated as described in the preceding section.

For Tumor.—If the veins are infiltrated or there are any signs of

intra-abdominal metastasis no search for glands in the abdomen should be made. But if the disease seems strictly localized the incision should be carried upward and outward parallel to the fibers of the external oblique to the tip of the eleventh rib or thereabouts (Bland-Sutton advises a vertical incision along the outer border of the rectus muscle). Through this incision the peritoneum is stripped forward until the spermatic vessels are identified running up from the inguinal canal; these are excised and the region internal to them and adjacent to the great vessels inspected and palpated for enlarged glands. These are removed in one mass with as much of the retroperitoneal fat as can be conveniently taken away. The glands will be found along the lumbar region and perhaps one gland at the iliac bifurcation.

OPERATION FOR CRYPTORCHIDISM

An oblique inguinal incision is made as for the operation of hernia.

Regardless of whether the testicle is inside or outside of the canal the incision is carried to the external oblique which is exposed down to the external inguinal ring and opened as for hernia.

The spermatic cord or hernial sac is then exposed by division of the fibers of the cremaster and lifted out of its bed. If the testicle lies in the inguinal canal or on the pubic bone its gubernaculum is clamped and cut and the rest of its attachments freed by blunt dissection. (If the testicle lies within the abdomen it is not seen until after the hernial sac is opened.)

If a hernial sac is not readily found this is carefully looked for at the upper end of the incision and when found is separated in the usual manner from the spermatic cord. (If the testicle is in the abdomen it may be felt within the internal ring and pulled out by traction on the gubernaculum.)

After separation of the spermatic cord from the hernial sac the testicle is grasped in a piece of gauze by an assistant and an effort is made to remove all the fascia and bits of cremaster from about the vessels and vas. If these tissues are well developed, the neatest procedure is to open each fascial compartment as though operating for varicocele or vasotomy, and having freed on the one hand the vas with its vessels, and on the other hand the pampiniform plexus, to separate these from their surrounding fascia, to divide the fascia and split it up over each vascular bundle thus freeing these immediately and completely. This procedure is most important and cannot always be done in this neat manner. Picking off tight bands of fascia here and there is the best we can do in many instances, and this process is not only slow, but also endangers the veins.

The testicle will now be found to have been loosened somewhat, but not quite sufficiently to permit it to lie loosely in the bottom of the scrotum. The testicle is once more held up and the finger passed along the vas (and later the vessels of the pampiniform plexus) up into the abdomen as high as it can reach, separating very gently the fascial sheath in which these structures lie. By this maneuver a very considerable additional length can be obtained, especially of the veins, and unless the testicle was actually at or near the internal abdominal ring, it will usually be found that the veins can be readily made much longer than the vas. If the vas still seems short this may be lengthened by nicking the fascia internal to the internal epigastric vessels, and slipping the testicle into the abdomen beneath the internal epigastric vessels and out again through the new hole. If, after every effort has been made, the pampiniform plexus still remains too short it must be sacrificed.

A bed is now made in the scrotum by inserting two fingers into this, and working a hole down to the very skin at the bottom-most part of this sac.

If the tunica vaginalis has not been opened and inverted in the course of the operation this is now done.

The scrotum is now turned inside out by the pressure of a finger at its base, and a chromic catgut suture caught through the deeper layers of the skin at this point and again carried through the tunica albuginea of the testicle, and at a point near its lower pole. Before this suture is tied one observes carefully that there is no twist of the spermatic cord. The suture is then tied tightly, the scrotum pulled downward, and the testicle thus placed in its bottom.

There is no need of any further traction. Sutures to the thigh, etc., do not hold the testicle in the scrotum unless it has been properly loosened from above, and if properly loosened it requires no stay suture.

The hernial sac is then tied off and the inguinal canal reconstructed as in the operation for hernia excepting that the cord is not transposed.

This operation should never be performed on children younger than eight or nine years of age. At this age they are sometimes rather unmanageable after operation, and it may be well to place the child in a plaster cast.

CHAPTER LXXX

OPERATIONS UPON THE PENIS

INCISION OF THE FORESKIN FOR CHANCROID

This little operation is performed under infiltration anesthesia, particular care being taken to anesthetize the mucous membrane. A grooved director is then inserted under the foreskin (not in the urethra, if you please), and upon this the skin and mucous membrane are split with scissors from the free margin well back to the corona.

It is better practice to make two such incisions, one on each side of the penis, as recommended by Taylor, rather than to make a single dorsal incision, which does not thoroughly expose the pockets on each side of the frenum.

Do not suture, but apply 25 per cent argyrol solution in the hope of preventing chancroidal inoculation of the wound.

CIRCUMCISION

Local Anesthesia.—The anesthetic solution is injected in a circle around the penis near its base, about one c.c. being injected on each side beneath Buck's fascia. This usually anesthetizes the whole surface, though additional infiltration into the mucosa near the corona may be required. If the prepuce cannot be retracted, a line of infiltration is made as far as possible within the mucous membrane on its dorsal aspect. This is then split up, the skin retracted, and the circle of infiltration completed.

During infiltration and throughout the operation a band of gauze should be kept tied about the shaft of the penis.

The Operation.—Catch the prepuce at its mucocutaneous junction above and below with artery clamps, and draw it forward as far as possible.

Now apply the circumcision forceps (long-bladed straight forceps). They are to be clamped on the foreskin at an angle of 60° with the long axis of the penis. The point of the forceps should be just behind the lower artery clamp, and great care should be employed not to include any of the glans penis in the grasp of the instrument (Fig. 189).

Cut away the redundant portion of the prepuce.

The forceps are now removed, and the skin slips back, exposing the connective tissue overlying the mucous membrane which adheres closely to the glans. This is to be slit down to the corona upon the dorsum, or laterally, and trimmed away on each side up to the frenum, leaving only enough tissue to hold the sutures. Old adhesions may be torn or cut away.

Ligature all bleeding points.

Catgut is the best material with which to suture the cut edges. The first suture should be applied at the raphé, then the others fall naturally in place. They should be applied very close together. Each one should take in the least possible portion of integument on the one side and of mucous membrane on the other. The ends of each alternate suture are left long.

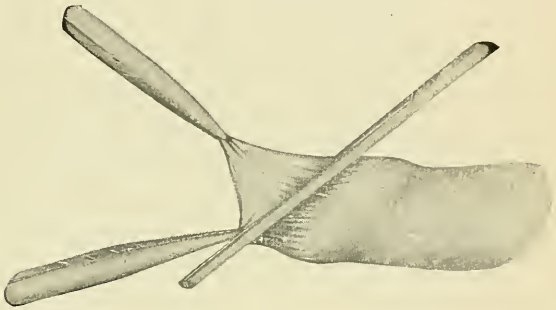

Fig. 189.—Method of Applying Circumcision Forceps.

By means of these long sutures a thick strip of gauze is tied turban-wise about the penis, covering the line of incision. This turban should be loose (Fig. 190).

This dressing is well greased with sterile vaselin, and covered with a loose piece of gauze (to be removed and replaced at each urination), held in place by a loose jockstrap.

After-treatment.—The patient need not be confined to bed.

The sutures begin to cut loose within a week. The turban is then cut away; the remaining sutures cut out spontaneously.

Complications.—*Wound infections* after circumcision, notably by tuberculosis and syphilis, have attracted the attention of many authors, and have been illustrated by many curious cases. But, except after ritual circumcision, they are practically unknown nowadays, and present no special features. More remarkable is the occurrence of *implantation cysts* which has several times been noticed after this operation.

AMPUTATION OF THE PENIS

General anesthesia is necessary. Ample skin-flaps (see below) are then cut and dissected back a full inch. From this skin incision a Y-shaped incision is carried up the dorsum of the penis and out over

both groins. Through this the dorsal veins and lymphatics are excised and with them the groin glands down to the saphenous openings.

Then the knife is inserted between the corpus spongiosum and the corpora cavernosa, and these bodies separated and amputated, the former being left 2 cm. longer than the latter. This step will be followed by violent hemorrhage from the corpora cavernosa. This is

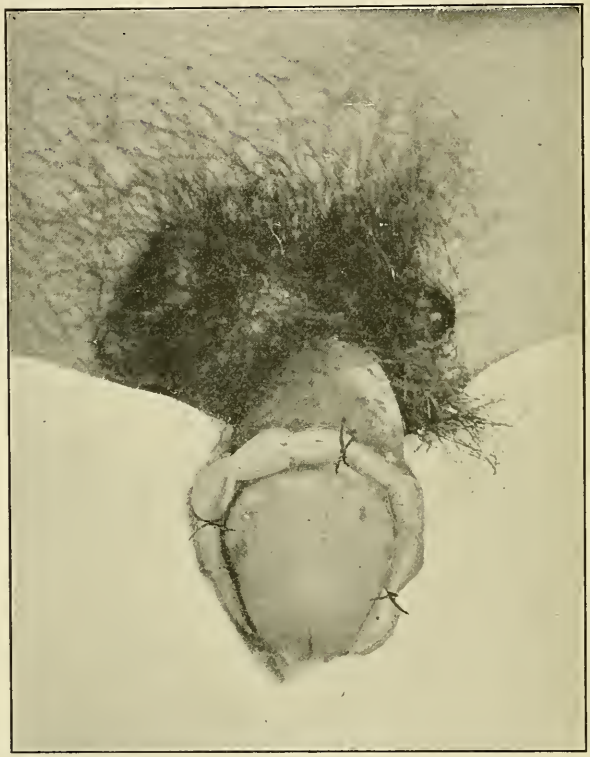

Fig. 190.—Dressing After Circumcision.

controlled by suturing the sheaths of the corpora to each other with chromic gut. Hemostasis having been thus effected, the urethra is split into two short flaps and these sutured with fine catgut to the skin. The wound is then dressed with the stump of the penis erect, and provision made for passage of the urine.

The wounds must be drained.

If the penis is to be amputated close to the pubes it is advisable to make a small buttonhole in the perineum, through which the urethra is sutured to the skin.

Flaps.—A circular skin incision was used by early operators, but flap operations are now in vogue as giving more accurate apposition of the skin edges and cleaner healing. Senn and Jacobson both use long

dorsal and short ventral flaps. Jacobson makes his so long that the urethra is sutured to a perforation in its lower part. Others prefer lateral flaps.

After-treatment.—If the flaps are cut long, erections need not be feared. A light dressing held snugly in place by adhesive plaster should prevent oozing. Frequent change of dressing is necessary to prevent defilement of the wound by urine. The patient should be examined for stricture of the new meatus some weeks after healing is complete.

EXTIRPATION OF THE PENIS

With the patient in the lithotomy position an incision is made encircling the penis, dividing the scrotum, and extending in an inverted Y from the central point of the perineum toward each of the ischial tuberosities. Through this incision the perineum is first dissected so as to expose the urethra and the corpora cavernosa on each side of it. The bulb is divided at a point about 3 cm. anterior to the triangular ligament, and the corpus spongiosum dissected free down to that structure. Between the two corpora cavernosa this dissection exposes the two arteries of the corpora, and the dorsal arteries of the penis as well. These four vessels are ligated and the corpora cavernosa then cut away from the pubic rami. The perineal wound is then sutured, the end of the urethra split and attached to the skin, the patient's legs let down upon the table, and the incision carried up into each groin. The glands are then excised down to the saphenous opening on each side, and the bundle of fat, glands and penis taken away in one piece.

The testicles may be removed as well if the patient elects.

It is convenient in suturing the scrotum to take up part of the flaps by making a transverse suture of the central portion of the loose scrotal skin. The wounds are otherwise closed as they were made with liberal drainage by rubber tissue.

APPENDIX

SYPHILIS

CHAPTER LXXXI

THE GENERAL CHARACTERISTICS OF SYPHILIS

Syphilis (the pox) is an infectious disease caused by the spirochaeta pallida. It is acquired by contagion or by heredity; it is chronic in course, indefinite in duration, essentially intermittent in character, manifesting itself by a succession of lesions which involve the whole body, and which are arbitrarily classified as primary, secondary, tertiary, and parasyphilitic.[1]

Syphilis is as varied in character as it is widespread in distribution. No country in the world, no organ in the body, is exempt from its taint. It shortens more lives than we can estimate, and its ultimate ravages are not yet known.

ACQUIRED SYPHILIS

The general characteristics of syphilis are best studied in its "acquired" form. The peculiarities of hereditary syphilis may be subsequently discussed.

The disease may be acquired only by contact with a syphilitic sore or with some substance upon which the secretion of a syphilitic lesion has been recently deposited. The infection does not travel in the air, nor do rooms occupied by syphilitics become infected. Moreover, it is probably incapable of piercing the intact integument.

The Primary Lesion.—Acquired syphilis always begins, after a few weeks' incubation, with an eroded papule at the point of inoculation. This lesion is called chancre, and is accompanied by a characteristic inflammation in the adjacent lymph glands. This chancre and adenitis constitute the *primary lesion.*

Generalization.—With the appearance of the positive Wassermann reaction, four to eight weeks after the appearance of the chancre, the generalization of the infection is obviously complete. Indeed generalization is doubtless accomplished by the time the inguinal glands are enlarged.

A few days or weeks later the *secondary lesions* appear. These consist of typical exanthemata upon the skin and mucous membranes,

[1] The classification of late sclerotic lesions as quaternary has been suggested, but is not generally accepted.

acute inflammations of certain organs (iritis, periostitis, meningitis, etc.), and evidences of general infection. The toxemia is often very light and generally lasts but a few weeks, while the localized secondary lesions have a tendency to relapse, after intervals of apparent health, for at least two years. These localized secondary lesions are infectious, superficial, and benign (i. e., tending to spontaneous cure, and generally speaking, not destructive of tissue nor productive of a permanent scar). They are malignant only in the sense that grave late lesions, notably those of the nervous system, probably develop upon insignificant early ones.

The Tertiary Lesions.—The tertiary lesions of syphilis may occur at any time after the appearance of the chancre. They may relapse after an interval of years. They rarely appear until after the first outbreak of secondary lesions has spent itself. In contrast to the secondary lesions they are clinically not infectious, are deep rather than superficial in location and malignant in that they destroy tissue and show little or no tendency to spontaneous cure. Histologically the tertiary lesion is either a specific syphilitic granuloma (gumma) or a diffuse interstitial sclerosis.

The Parasyphilids.—Finally, there is a class of lesions, the pathology of which does not at first sight suggest syphilis, termed by Fournier the parasyphilids. These lesions occur usually after the other syphilitic lesions have ceased to appear. They are relatively rebellious to antisyphilitic medication.

The exact nature of the parasyphilids was not clear until, within the last few years, the development in the seropathology of syphilis has proven them all truly specific.

Are There Periods of Syphilis?—The above classification is an arbitrary one. The primary lesion is definite and immutable (though it may be overlooked), but beyond this all is variable. Secondary lesions may be so mild as to pass unnoticed. Tertiary lesions may never occur, or they may appear before the secondary, or the two may exist side by side or, more confusing still, a given lesion may be on the border line, perhaps secondary, perhaps tertiary; and a superficial lesion, apparently secondary at first, may later develop the characteristics of tertiarism. Moreover, parasyphilitic lesions may co-exist with tertiary manifestations.

Hence there is no such thing as a purely secondary or tertiary period of the disease. Secondary symptoms; yes. Tertiary symptoms; yes. Periods; no. The terms secondary and tertiary are conventional symbols to express the quality of certain symptoms. It is utterly misleading to apply them to periods of time when these periods so overlap as to produce confusion from the use of terms whose only purpose is to prevent confusion.

TRANSMISSION OF SYPHILIS

Experimental investigations upon monkeys have confirmed the accepted theories of syphilitic infection.

We have learned that the spirochete is the infectious agent, and that infection is most common from the chancre and the secondary lesions. But, inasmuch as rather intimate contact with the secretions of a syphilitic lesion is essential to infection, it is probable that of the secondary lesions only the moist papules and ulcers are clinically infectious. Dry secondary lesions and tertiary lesions do not transmit the spirochete even though they contain it. They are not infectious.

There has always been question, however, of the virulence of the secretions of the syphilitic, notably his semen, and also of the virulence of his blood, notably in reference to surgical operations. That the secretions may be virulent is proven by the discovery of spirochete in the nares, on the conjunctiva, in the epithelium of the bowel and of the kidney in hereditary syphilis, while a monkey has been infected by the apparently normal semen of a syphilitic man.

Whether in each of these instances some minute syphilitic lesion was present and accounted for the exudation of spirochetes is a purely academic question. The clinical fact remains that the overwhelming infection of severe hereditary syphilis may produce an infectiousness of all the apparently normal secretions; while in acquired syphilis the apparently normal semen may be infectious.

That infection from such sources must be rare, however, is shown by the numerous failures of inoculations made with mothers' milk, with urine, with semen, etc.; and the danger of such infection is probably extremely small unless from the prolonged contact possible in seminal transmission.

The danger of infection from syphilitic blood is even slighter. The spirochetes are present in the blood only in the most florid stage of the disease. The real danger of infection with syphilis lies in the mucous ulcer or papule, which may exist unsuspected and even undiscoverable about the mouth or genitals.

Whether, as has been alleged, a clean woman may act as an intermediary host and convey the virus from a syphilitic partner to a clean one, and yet escape infection herself, would be hard to prove, though such an accident is eminently possible.

EXTRAGENITAL AND NON-SEXUAL INFECTION

Though syphilis occurs in all lands and at all ages, it is relatively much more common in some countries than in others. Thus in some of

the Balkan states and in certain parts of Russia and Asia Minor, in many tropical countries, and in certain isolated communities, syphilis is practically endemic. Everyone has the disease, and it is transmitted fully as commonly by extragenital as by genital contact. In the United States, however, the disease, though universally distributed, probably affects a smaller proportion of the community than in most countries; and, inasmuch as we do not indulge in kissing and other forms of personal endearment so much as our European neighbors, extragenital infections are relatively uncommon among us.

Among some 2,200 syphilitic men I found but 70 instances of extragenital chancre; while among 207 syphilitic women, 21 showed or gave history of extragenital chancre. This proportion—about 3.5 per cent for men and 10 per cent for women [1]—confirms the accepted belief that women are more often innocently contaminated than men, while the method of contamination is sufficiently indicated by the following table, in which practically all chancres of lip, tongue, and tonsil were due to kissing, while almost all the finger chancres in men occurred in doctors and were due to vaginal examination, only one of them being attributed to infection during a surgical operation. The breast chancres were acquired by nursing syphilitic infants. A chancre of tongue or tonsil may surely be acquired by simple lip contact with an infected surface, just as urethral chancre may result from normal coitus.

Extragenital Chancre

TABLE

Male	70 cases	*Female*	21 cases
Finger	34 "	Lip	13 "
Lip	24 "	Finger	2 "
Tongue	4 "	Vaccination	2 "
Tonsil	2 "	Breast	2 "
Abdomen	2 "	Tonsil	1 case
Cheek	1 case	Eyelid	1 "
Chin	1 "		
Eyelid	1 "		
Arm	1 "		

Although the disease may only be transmitted by inoculation of the secretions from the primary or secondary lesions, and although, theoretically at least, the possession of an unbroken integument protects from danger of infection with syphilis, one can never be absolutely sure that a patient in the first two or three years of syphilis has not some in-

[1] Fournier has tabulated 10,000 chancres (96 per cent of them in men), of which 94 per cent were genital in man and only 63 per cent in women.—They kiss everyone in France.

significant lesion of mouth or genitals whose presence he does not realize, nor can one be sure of an absolutely unbroken integument. It cannot be too often repeated—syphilis is frequently transmitted by a person who believes he has no lesions of syphilis upon him to a person who believes his integument intact.

Does Exposure Necessarily Imply Infection?—No; emphatically not. The physician who has the confidence of his patients will occasionally come upon cases where exposure, even repeated exposure, has not resulted in infection.

The following set of cases related to me by Dr. John F. Connors may serve as an example: Eleven men were repeatedly and in rotation exposed to infection from a single woman. They thought themselves well and she was not obviously diseased. Yet 6 of them contracted gonorrhea and chancroid, 4 syphilis and chancroid, and 1 chancroid alone. Total, chancroid, 100 per cent; gonorrhea, 55 per cent; syphilis, 36 per cent.

When Does Syphilis Cease to Be Infectious?—Since the probabilities are so vague, what are the possibilities? The question is by no means easy to answer. Certainly 8 out of 10 syphilitics cease to be infectious within three years. Certainly 99 men out of 100 cease to be infectious within five years. Certainly the proportion of infections from syphilitics of more than five years' standing is infinitesimal, and if the patient, at the end of the fifth year of his disease, has been two years without symptoms or treatment, he may be guaranteed for matrimony, though against (noninfectious) relapses in his own person he may never be wholly guaranteed.

SYPHILIS AND MARRIAGE

The danger of marital infection is instant, and the chances for it are overwhelming during the first year of the disease, much less in the second year, 1 to 4 in the third year, and all but nothing after the fifth year—whether the patient has been well treated or not.

The syphilitic woman bears syphilitic children for ten years or more. But after the fifth year she does not infect her husband.

Most practitioners are willing to assure their patients that after three years of treatment all danger of transmitting the disease is past. Yet this is by no means an absolute rule. Tarnowsky has reported [1] the transmission of syphilis in the fifth, sixth, ninth, tenth, and fifteenth years. Neumann [2] accepts the possibility of contagion between the fifth and the tenth year, and perhaps later. Fournier relates 3 infec-

[1] *Third Internat. Congress of Dermatology,* 1896.

[2] *Wien med. Presse,* 1899.

tions during the sixth year, 1 in the seventh, 6 in the eighth, 3 in the ninth, 2 in the tenth; but at this point even Fournier falters. He relates cases of supposed infection at the end of twelve, thirteen, and seventeen years; but confesses that "in view of the complexity of the subject and the great possibility of error in so delicate a matter, these cases are as yet too few to warrant any conclusion being drawn from them."

But Fournier is an extremist. He stands almost alone in his horror of late infections. Twenty years ago he acquiesced in matrimony at the end of five years of syphilis; today he says: "If my son contracted syphilis, I should not permit him to marry before the sixth or seventh year of the disease."[1] We can afford to be a little milder and assert that matrimony is often safe and sometimes justifiable at the end of three years, but unless the social elements at stake are very great it is more prudent to follow the rule that *marriage of a syphilitic is permissible only after five years, during the last two of which he has been without symptoms and without treatment.* The occurrence of symptoms, especially if they be secondary symptoms, after the third year of the disease should postpone matrimony until two years have elapsed since the termination of the treatment required to cure these symptoms.

The reason for requiring two years of health is this: Late infections, like early ones, are due practically always to contamination by secondary lesions in the mouth and upon the genitals. Of the 18 cases related by Fournier in which infection occurred between the sixth and seventeenth years of the disease, 10 were buccal and 8 genital infections. Now these lesions are likely to relapse persistently and without long intervals of health.[2] Consequently, the lapse of two years without such lesions is a sufficient guarantee that they will not recur. If the patient is an inveterate smoker, he should be warned of the danger of relapsing lesions of the tongue to which his habit subjects him. Curiously enough, several patients had been repeatedly warned of this danger before they succeeded in infecting their wives.

A repeatedly negative Wassermann reaction should be required as evidence of continued health.

Finally, let it be remembered, the moral aspect of this question must carry fully as much weight as the physical. To prohibit matrimony in a given case may wreck a man's life even more completely than syphilis could blast his wife's, and though this consideration can have no force in the first two years of the disease when infection is all but certain, in the fourth and fifth years one may make exceptions for adequate social cause and with due precautions, deeming the possibility of infection light in comparison to the certain despair implied by delay. After the

[1] *Bull. de la soc. franc. de prophylaxie san. et mor.*, 1906, v. 125.

[2] Whereas tertiary noncontagious lesions often relapse after many years of health.

fifth year it is wiser even to urge matrimony, for nothing so completely disarms syphilis of its terrors as the possession of a calm fireside, a happy wife, and a ruddy child. Many a man has been driven to this happiness like a whipped cur, and has found in it a fullness of content which the medicines and maxims of no physician could provide.

SALVARSAN AND INFECTIOUSNESS

The above paragraphs were written before the discovery of salvarsan. In how far are they modified by proper modern treatment? Doubtless to a great extent. But though we now frequently feel morally certain that certain patients are no longer infectious after their first course of salvarsan, we may be equally certain that infectious lesions *may* relapse many months thereafter. Perhaps it is as well to withhold matrimony for five years until we are a little more assured of what the future holds.

HEREDITARY SYPHILIS

A syphilitic father may beget a syphilitic child without apparently infecting the mother; yet this mother cannot be infected with syphilis by nursing the child (Colles's law), although the child will promptly infect any other wet-nurse. Moreover, the mother of such a syphilitic child, although herself remaining healthy many years, almost invariably ultimately breaks out with tertiary syphilis (*choc en retour*). Manifestly, therefore, the mother of a syphilitic child, even though she remain apparently sound, is syphilitic.

The danger of transmission from father to child ceases in from two to five years if the father is properly treated. Under inefficient treatment paternal virulence may last indefinitely, though it is likely to terminate within five years in any case.

The danger of transmission from mother to child does not, however, terminate at any definite time. Some mothers continue to bear syphilitic children for years after the disappearance of their own symptoms. That such cases are exceptional does not lessen their importance.

And the child itself. It may die *in utero* and be expelled as a fetid disorganized mass. It may be born to live but a few days. It may reach maturity, bearing in mind and body the scars of its parent's misfortune. It may remain well many years only to fall victim to an unsuspected "delayed hereditary syphilis." It may not be infected. Freaks of fortune and effects of treatment ring every possible change. Of twins even, one may be born apparently healthy, the other syphilitic. But, generally speaking, the infection lessens with each succeeding

conception. Thus, when a man in the infectious stage of syphilis marries, the first product of conception usually dies *in utero,* and miscarriage of a deformed, macerated fetus ensues. After one or more such mishaps a child is born, cachectic, perhaps actively syphilitic at birth or soon showing evidences of the disease. Such children usually die promptly. Later children are born which show no signs of the disease at first, and may either remain well or show certain stigmata of syphilitic heredity, or become actively syphilitic.

Hereditary syphilis is the same disease as acquired syphilis. But its lesions are modified by the undeveloped condition of the organism attacked as well as by the mode of infection. There cannot be said to be any port of entry for the virus (unless it be the placenta); hence there is no chancre, no primary lesion.

The secondary infectious lesions are sometimes skipped (or overlooked) in hereditary syphilis, and the so-called delayed hereditary syphilis is always tertiary in type.

But the overshadowing features of hereditary syphilis are the virulence with which it overwhelms the infant and the characteristic developmental deformities it imparts, deformities especially of the teeth, the cranium, and the remainder of the skeleton. These are called the syphilitic dystrophies.

The details of hereditary syphilis are dwelt upon in Chapter XC.

HEREDITARY SYPHILIS OF THE THIRD GENERATION

In face of a general agreement of authorities as to principles, and in spite of the divergent interpretation of details, one must at least confess that hereditary syphilis in the third generation is possible, though it must be eminently rare. And one may add by way of precaution that the other factors in heredity—especially in the production of congenital dystrophies, such as alcohol, privation, etc., whose influence is so marked upon syphilis in the first and second generation—must be important elements, and are perhaps even *the* important elements in determining syphilitic heredity—especially dystrophic heredity—in the third generation.

THE SECOND ATTACK OF SYPHILIS

A second attack of syphilis is no more intrinsically impossible than a second attack of small-pox or malaria. The rarity of reinfection is due in the first place to the persistence of the initial infection, and in the second place to the fact that most men who get well of their first infection do so at a time of life when they are not much exposed to

reinfection. Hence one may put some faith in the rumors from countries where syphilis is endemic that the hereditary syphilitic is often found to be reinfected during adult life. Its rarity, however, is attested by the fact that neither Fournier, Barthelemy nor my father ever saw a case. I have seen but one; a patient of my father who, having been treated and apparently cured by him twenty-five years ago, consulted me with a perfectly typical picture of chancre, inguinal glands and general maculopapular eruptions and a positive Wassermann reaction, all of which promptly receded under salvarsan treatment combined with mercury.

But since the introduction of salvarsan medical literature has been deluged with reports of alleged reinfection within a few months of an apparent cure by salvarsan. Such cases have usually been treated at the very onset before the appearance of any subjective secondary symptoms other than perhaps a positive Wassermann reaction. An intensive course of salvarsan has resulted in the disappearance of the Wassermann reaction and of the chancre and glands. Within a year, however, the chancre reappears and a so-called second attack of syphilis develops in the usual way. It would indeed be surprising if, in the majority of these cases, there were not a history of recent sexual exposure before the appearance of this so-called second chancre. But I happen to have seen one such develop without any history of re-exposure and quite a number of similar cases have been reported. Indeed these supposed reinfections are, in the majority of instances at least, quite comparable to the so-called neurorecidiv (p. 828), an evidence that the spirochetes have been almost all killed, and the patient's reaction to them absolutely annihilated. If this occurs early enough in the primary stage the few remaining spirochetes are to be found in the scar of the chancre and there develop again and produce upon the unimmunized patient a new attack of syphilis. If this destruction of spirochetes occurs later in the disease, the persistent focus of infection is likely to be somewhere in the nervous system and it begins anew with the shocking results known as neurorecidiv.[1]

It is an essential characteristic of the true reinfection after abortion of syphilis that the second chancre should appear on a different spot from the first one.[2]

[1] Cf. *Dermatolog. Wochenschr.*, January 13, 1912.

[2] Cf. Paraounagian, *N. Y. Med. Jour.*, Jan. 22, 1916.

CHAPTER LXXXII

ETIOLOGY, SEROLOGY, AND PATHOLOGY OF SYPHILIS

In May, 1905, Schaudinn and Hoffmann, while endeavoring to identify the cytorrhyctes luis (Siegel), one of the alleged causes of syphilis, observed a hitherto undescribed organism in the secretions from syphilitic sores. The publication of their findings was immediately followed by confirmatory evidence from all parts of the world. Metchnikoff and Roux not only confirmed the observation, but called

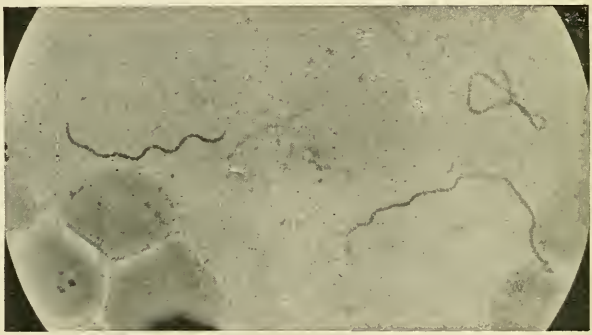

Fig. 191.—Spirochaeta Pallida (two in center) and Refringens (three, more deeply stained). (Hoffmann.)

attention to the fact that Bordet and Gengou had previously observed the microörganism in certain syphilitic secretions, but not finding it constantly, had dropped further investigation. Levaditi found it in lesions of congenital syphilis. Bertarelli, Volpino, and Bovero were able to identify it in stained sections of syphilitic organs. Larrier and Bergeron identified it in the blood of syphilitic patients, and innumerable observers in every country have noted clinically that the organism may be found in almost every lesion of early untreated syphilis, though most common in the most infectious lesions.

Final proof that the spirochaeta pallida is the cause of syphilis was provided by Noguchi's cultures and inoculations from various syphilitic lesions, notably the spinal cords of tabetics and brains of paretics.

THE SPIROCHAETA PALLIDA

The spirochaeta pallida (spironema, treponema [1] pallidum) is a motile spiral organism (Fig. 191), varying in length from 4 to 14 μ, in diameter from an immeasurable thinness up to about $\frac{1}{4}$ μ; it is cylindrical, not flattened; its spirals usually number from 6 to 14, though as high as 20 and 25 have been counted in exceptionally long ones. The length and depth of the spirals vary from 1 to 1.5 μ.

Whether in motion or at rest, alive or dead, the spirochaeta pallida never loses its spiral shape.

Methods of Staining.—For the examination of living specimens the *dark-field illumination* is always employed, for in the dark field the characteristic shape and motion of the spirochaeta pallida distinguish it clearly from all similar organisms.

The sediment to be examined should contain neither pus nor blood nor other microörganism. It is least likely to be contaminated if the lesion is brushed several times lightly with the finger covered with several layers of gauze. This suffices to remove the secretion lying upon the surface of the sore, and to excite a slight serous exudate. After about ten minutes a drop of this exudate is picked up on the platinum loop and transferred to the dark field microscope. The characteristics of the spirochete as seen under the microscope are its relatively great length and thinness, the sharpness and regularity of its spirals, and its constant movement. It progresses, it bends from end to end, and it rotates.

The spirochete takes the ordinary bacterial stains very badly. The standard Giemsa method is very complex as compared with the India ink stain.

The latter is made as follows:

A small drop of the serum, mixed with an equal amount of distilled water, is diluted with about half as much India ink and spread very thin on the slide. The smear must not be fixed by heat. It dries very rapidly. The spirochete shows as a white or translucent body in the surrounding black field.

The spirochete may be readily identified and distinguished from other organisms in smears taken from the genitals or aspirated from the glands. But spirochete diagnosis made from material obtained from the mouth should be accepted with much reserve, unless the microscopist is truly skilled in this branch of work; for the spirillum microdentium very closely resembles the spirochaeta pallida.

[1] The name "treponema" was suggested by Schaudinn as more accurately descriptive of the exact nature of the parasite. But this name has met with no general favor.

Tissue Stain.—The best is Levaditi's modification of the Ramon y Cajal silver stain.[1]

1. Sections are cut 1 mm. thick and hardened in 10 per cent formalin for twenty-four hours.

2. Wash and harden in 96 per cent alcohol twenty-four hours.

3. Wash a few minutes in water until they sink.

4. Impregnate with silver by soaking for three (to five) days in a 1.5 per cent (to 3 per cent) solution of silver nitrate at a temperature of 38° C.

5. Wash rapidly in water and place for twenty-four (to forty-eight) hours at the room temperature in

Acid pyrogallic	2 gm.;
Formalin	5 c.c.;
Aq. destill.	100 c.c.

Distribution.—Sufficiently expert and conscientious investigation reveals spirochaeta pallida in fully three-fourths of the smears taken from chancres, moist papules, and mouth lesions.

It was to be hoped that aspiration of the lymph nodes adjacent to the chancre might prove a simple means of obtaining uncontaminated smears of spirochaeta pallida; but, unfortunately, the microörganism is rare in the center of nodes, being chiefly confined to the region of the periphery, so that there is a distinctly less probability of finding them there than in the chancre itself.

Though the later secondary lesions contain fewer spirochetes, these have been found as late as nine years after chancre by Sobernheim and Tomasczewski.

They have been found in the pus from a nonsyphilitic abscess occurring during the acute stage of the disease (Flügel), in the serum of blisters raised by cantharides (Levaditi and Petresco), in albuminous urine (Dreyer and Toepel), in the blood—after many failures, and only during the first few months and before the beginning of mercurial treatment (Nöggerath and Stähelin, Schaudinn, Richards and Hunt *et al.*).

The search for *spirochetes in tertiary lesions* was, for a long time, fruitless, but was finally crowned with success. Tomasczewski, who has found them in 5 out of 10 gummata examined, states that eight to ten hours must sometimes be spent in examining smears before finding a typical spirochete.

The crowning success fell to Noguchi, who was able to demonstrate the spirochete in paretic brains, thus delivering the final blow to the

[1] The so-called old Levaditi, in contradistinction to the new or pyridin Levaditi, which is quicker but not so accurate.

theory of "parasyphilids," and proving paresis to be as fully syphilitic as any other lesion of the disease.

The moist lesions of early hereditary syphilis swarm with spirochetes, and they have been found (either in smears or in sections) in practically all the organs of still-born syphilitic infants—viz., liver, lung, spleen, kidney, suprarenal, muscle, heart, stomach, intestine, mesenteric glands, gall-bladder and ducts, ovary, uterus, prostate, testis, urinary bladder, thymus, tonsil, bone, joint, etc. They are usually most numerous in the liver, lungs, and skin. They have been found in both fetal and maternal placenta, and once in the inguinal glands of the apparently healthy mother of a syphilitic child (Buschke and Fischer)! Curiously enough, masses of spirochetes are sometimes found in and about the capillaries where no tissue change has taken place.

The examination of normal secretions—except the semen—is negative, except in severe congenital syphilis.

Cultivation.—All attempts to grow spirochetes outside of the living organism proved failures until Noguchi succeeded not only in growing the organism and transmitting the disease to animals by spirochetes several generations removed from their human host, but also in making from his cultures a vaccine, to which has been given the name of "luetin."

EXPERIMENTAL SYPHILIS

Syphilis, as known in man—a disease characterized by an initial lesion and subsequently by various systemic manifestations—can be produced by inoculation only in the anthropoid apes. Other animals can be inoculated with syphilis and then show an initial lesion and certain other lesions of a relatively mild sort. Indeed there is reason to believe from the results of animal experimentation that certain strains of spirochetes tend to produce certain types of lesions.

But the most important practical conclusion yet reached from these experiments is that *syphilitic secretions cease to be infectious after twelve to twenty-four hours, and much sooner (at most six hours) when dry.* This explains why we are not all infected by cigars and why the syphilitic may live and dine with his family in absolute safety so long as the cups, forks, and spoons that enter his mouth are washed and dried before being used by anyone else at the following meal.

Prophylaxis.—As soon as Metchnikoff and Roux had proved to their satisfaction the transmissibility of syphilis to monkeys, they turned their attention to its prophylaxis. The results of their experiments were startling. They found that *excision of chancre, even of commencing chancre, is entirely futile as a preventive or minimizer of the subsequent development of the disease.* Cauterization of the chancre

they found equally futile. Indeed, *wide excision of the inoculated area at any time later than eight hours after inoculation failed to prevent the development of chancre*[1] (confirmed by Neisser). Moreover, cauterization of the site of inoculation (to destroy the virus) and various antiseptics availed nothing.

The only way in which they were able to destroy the virus after inoculation was by applying, within six hours, a calomel salve (calomel, 20; lanolin, 40). So universally preventive did this prove that they performed a confirmatory inoculation (with monkey controls) upon a medical student, inoculating him with the virulent secretion of a chancre and of a mucous papule, rubbing in the calomel salve within one hour, and watching him long enough to be sure that no sign of syphilis developed.

Hence we may infer that *the only personal prophylaxis against syphilitic infection lies,* not in cauterization or excision, but *in inunction with a strong mercurial ointment within one hour*[2] *of inoculation.*

Inoculation Immunity.—All efforts to develop artificially either an active or a passive immunity to syphilis have failed in man as well as in monkey. Taking as a starting point the immunity to reinfection, which begins so early in the disease (tenth to fourteenth day), and usually lasts a lifetime, inoculation experiments have been made with the blood serum of syphilitics, with the juices from syphilitic lesions (filtered through porcelain), as well as by "passing" the infection through several individuals. The result has been absolute zero: as yet "the only way to be immune to syphilis is to have it."

THE WASSERMANN REACTION

Among the innumerable serological tests that have been suggested for the diagnosis of syphilis, the Wassermann reaction alone survives. But two modifications of the reaction are worthy of comment.

1. Wassermann originally employed an antigen derived from the liver of a syphilitic infant for he believed his reaction specific. But experience has shown that other antigens give as accurate results as the syphilitic liver. It is recognized that the reaction is not, strictly speaking, specific for syphilis, but may occur under various other conditions. The antigen commonly employed is an alcoholic extract of bullock's heart.

[1] But in one case amputation of an inoculated ear after twenty-four hours was preventive, and the monkey was subsequently successfully inoculated. On the other hand Neisser has transmitted the disease by inoculation with the blood of an animal still in the primary incubation (before the appearance of a chancre).

[2] Clinical application of this test has, however, failed to prevent the appearance of chancre in three reported cases.

2. The antigen may be made much more delicate by cholesterinization. The status of the cholesterinized antigen is not yet fully determined. Quite possibly (indeed such is my own impression) this antigen as ordinarily employed is actually too sensitive and gives strong positive reactions in some patients who are not syphilitic.

Indeed the fundamental inaccuracy of the Wassermann reaction is recognized in all laboratories. Those that use a cholesterinized antigen, also use an alcoholic antigen and many, as a further control, use a lipoid extract of the bullock's heart which gives even weaker reactions.

It is not our province to describe the Wassermann reaction nor to comment too precisely upon its results for these depend upon the intelligence with which they are interpreted.

Each clinician must familiarize himself with the work of a given laboratory and control its results by a great number of known nonsyphilitics (persons with no evidence, lesion or history of the disease). The reaction should exhibit the following qualities:

1. Nonsyphilitic patients suffering or convalescent from pneumonia, scarlatina, active tuberculous lesions, and patients with acidosis, whether due to diabetes or to other cause may show a positive reaction. So may patients in the terminal stages of carcinoma, certain lepers, sufferers from yaws, etc.

2. An unexplained positive Wassermann reaction will be found in about 10 to 20 per cent of hospital cases among adults. The majority of these are doubtless syphilitics who have overlooked their early lesions. For such cases the typical changes in the spinal fluid, the absence of ankle jerk, or even the history of a chancroid constitute evidence of syphilis. In private practice a good Wassermann reaction is positive in probably not more than 1 or 2 per cent of nonsyphilitic cases.

3. In early syphilis the Wassermann reaction becomes positive sometimes at the end of the first week, practically always in the third or fourth week, and literally in 100 per cent of cases between the eighth and the tenth week.

4. Untreated cases of syphilis, notably those suffering from tabes, not infrequently show a negative Wassermann reaction though the great majority of them are positive.

5. During the first two years of the disease treatment, notably by salvarsan, may make the Wassermann remain negative even after the relapse of lesions.

6. If salvarsan has not been employed the reaction may be expected to be positive in about 90 per cent of cases showing active lesions in the first three years of the disease.

7. In a period of remission the Wassermann will usually have been made negative by the treatment employed. In the later years of the

disease the Wassermann reaction is likely to become positive before somatic lesions reappear.

8. Active tertiary lesions are accompanied by a positive Wassermann reaction in about 80 per cent of cases.

9. Tabes shows a positive blood Wassermann reaction with relative rarity, probably in not over one-half of the cases.

10. The blood Wassermann is positive in at least 90 per cent of paretics.

11. The reaction may sometimes be made negative for two days by a few alcoholic drinks.

The Provoked Wassermann Reaction.—The so-called Herxheimer reaction is an increase in the active skin lesions of syphilis as the immediate result of treatment. Such a reaction not infrequently follows the administration of salvarsan for the cure of secondary skin lesions.

It is explained on the theory of local irritation due to the liberation of toxins from the great number of spirochetes suddenly killed.

The provoked Wassermann reaction is apparently a similar phenomenon. The reaction is this:

Within twenty-four to forty-eight hours after an injection of salvarsan, the Wassermann reaction, which has previously been negative, becomes positive, or if mildly positive it becomes more so. This positive reaction may be of very brief duration. It usually occurs at the end of forty-eight hours though it may be delayed until the end of a week, and if a series of salvarsan injections are being given, the second or third injection may make the blood become more positive than the first did (under these circumstances the injections must be continued until the blood becomes negative if that is possible). The provoked Wassermann may usually be obtained in patients showing lesions of the disease but a negative Wassermann reaction before treatment. Patients who are known to have syphilis or are suspected of having syphilis, but who have no active lesions, sometimes give a provoked Wassermann and sometimes do not. The prognosis of the latter class of cases is believed to be much better than the former.

THE LUETIN TEST

The luetin test is analogous to the von Pirquet reaction for tuberculosis. Luetin is a fixed dilution of killed spirochetes. It is injected into the skin in a dose of 0.05 c.c. The reaction[1] usually appears within twenty-four hours, sometimes later. It may be papular, pustular or torpid. The papule is large, raised, red, indurated and usually from

[1] Noguchi, *Jour. of Exp. Med.*, 1911, xiv, 557.

.05 to 1 cm. in diameter. It appears in twenty-four hours, increases for three or four days, and then gradually subsides. It may become pustular on the fourth or fifth day, and may be accompanied by slight fever. The torpid form produces a small pustule after an interval of a week or two. Noguchi [1] has collected statistics which show that the reaction is positive in 30 per cent of cases of primary syphilis, in 47 per cent of secondary syphilis, in 80 per cent of tertiary syphilis, in 70 per cent of congenital syphilis, in 60 per cent of nervous syphilis, and in 90 per cent of visceral syphilis. He states that the luetin reaction indicates the allergy and the Wassermann reaction the presence of an active syphilitic process. The two reactions usually agree though one may be positive and the other negative. He believes the luetin reaction more accurate in chronic tertiary syphilis not in the nervous system.

I have never employed luetin.

SPINAL FLUID TESTS

The four tests made upon the spinal fluid are:

The Globulin Reaction.—The presence of globulin in the cerebrospinal fluid means organic disease in the nervous system, but does not declare the nature of that disease. (Certain cases of cerebrospinal syphilis show a negative globulin reaction.) Globulin is the first reaction to become positive on the appearance of syphilis of the nervous system and the last to become negative. Noguchi's test is the one usually employed. To 0.2 c.c. of spinal fluid is added 0.5 c.c. of a 10 per cent butyric acid solution in normal saline solution. The two are boiled, 0.1 c.c. of a 4 per cent sodium hydrate solution added, and the mixture again heated. The result is read at the end of one-half hour, and at the end of twenty-four hours. The fluid varies in cloudiness from an opalescent to a coarse thick precipitate. An opalescent is negative, a heavy precipitate is called double plus.

Lymphocytosis.—The normal spinal fluid may contain as many as five cells to the cubic millimeter (Nonne). Syphilis of the nervous system almost always produces an increase in the number of lymphocytes (mononuclear cells) in the spinal fluid. In chronic cases, such as tabes, the increase is usually not very great, the cell count running from 10 to 30 or 40. Active cases and paretics often show a very high cell count (as high as 500). Under these circumstances the spinal fluid is distinctly cloudy.

The Wassermann Reaction.—The Wassermann reaction is positive in the spinal fluid of 98 per cent of paretics, 60 per cent of tabetics,

[1] *N. Y. Med. Jour.*, August 22, 1914, c, 349.

and about the same percentage of cerebrospinal syphilis. The Wassermann reaction should, like the blood Wassermann, be performed with at least two or three different antigens, and in a series of dilutions of the spinal fluid from 1 down to 0.1 c.c. Paresis is likely to give a Wassermann reaction in all of these dilutions, tabes and cerebrospinal syphilis only in the stronger concentrations.

The Colloidal Gold Test.—The reaction[1] consists in mingling in various dilutions colloidal gold with the cerebrospinal serum. The test gives a fairly suggestive curve in syphilitic cases but gives absolute decolorization in the stronger concentrations only in cases of paresis for which it is a peculiarly accurate test.

Pressure.—It is customary to endeavor to estimate the pressure at which the cerebrospinal fluid issues into the needle. So many mechanical elements enter into consideration here, however, that in most instances the results are quite valueless.

Precaution.—The amount of cerebrospinal fluid required to make all of the above tests is about 8 c.c. *The cell count must be made immediately;* otherwise the cells stick to the bottom and sides of the tube. The other reactions may be made at leisure. The puncture is made in the usual way in the third or fourth lumbar space.

It is essential that the patient remain in bed for at least forty-eight hours after a lumbar puncture. The penalty for infraction of this rule is severe pain in the head and back of the neck which may prove totally debilitating for several weeks.

THE PATHOLOGY OF SYPHILIS

"The syphilitic process is essentially a granuloma having its origin in the perivascular lymphatic spaces" (Fordyce). The spirochetes appear both in the lymph and the blood and during the so-called secondary incubation period they spread to and from lesions in the blood vessels in most of the internal organs as well as in the skin. An increase in the lymphocytes of the spinal fluid occurs in from 20 to 40 cases of early secondary syphilitics, in some instances even before the appearance of the secondary skin eruption (Wile).[2] An increase in the polynuclear leukocytes and in the eosinophiles, as well as the occasional increase in temperature and appearance of jaundice and enlargement of the spleen, give evidence of the acute systemic character of the infection. If the patient submits to no treatment he goes through an early outbreak (as it is called) of varying severity, after which the lesions tend to disappear because of an acquired immunity. This immunity is, however,

[1] Cf. Miller, *Bull. Johns Hopkins Hosp.*, 1914, xxv, 113.

[2] *Jour. A. M. A.*, 1913, lxiv, 1465.

only partial and not sufficient to cure the disease. Thereafter all is confusion. The lesions may relapse soon or late, moderately or severely, in the viscera, the nervous system or the skin. There is grave reason to doubt whether syphilis is actually curable after the first general outbreak has occurred. The syphilitic is curable in the sense that he can often get into a condition where his Wassermann reaction remains negative, and he remains free from symptoms so long as he is not debilitated by trauma, grave disease, or alcoholic or other excesses. He may, moreover, after the lapse of time be absolutely guaranteed against the possibility of transmitting the disease to wife or child. But in his own person the guarantee of cure, even clinical cure, is never absolute but depends upon keeping himself in good condition.

Lesions of the Capillaries.—With a few exceptions the lesions of syphilis may be classed as perivascular granulomata—i. e., infiltrations of the vessel walls and of the surrounding tissue with small, round cells and plasma cells. The vessels most commonly affected are the capillaries.

Syphilis is, therefore, classed (with tuberculosis and leprosy) among the infectious granulomata.

The congestion and proliferation shows itself by dilatation of the vessel lumina, swelling and proliferation of the endothelium, and formation of new capillaries.

The exudation occurs in a "coat-sleeve" fashion, surrounding the inflamed vessels with a zone of infiltrate many times the diameter of the vessel itself. This zone gradually merges at its edge into the surrounding normal tissue. Groups of capillaries are usually affected and, when the inflammation is at all marked, the zones of infiltrate merge into one another to form an irregular area more or less widespread.

The exudate consists of small round cells and plasma cells. Here and there a giant cell is sometimes seen. These giant cells are neither constant nor characteristic of syphilis (they are much more common in tuberculosis).

The reaction of the exudation upon the capillaries themselves is most important. The vessels are primarily—

1. Congested and proliferated, and secondarily—

2. Thrombosed, "their former site being marked by solid cords, groups of irregularly disposed cells with pale staining nuclei and giant cells with peripheral or central nuclei or both" (Fordyce[1]). Without discussing further the disputed origin of the giant cells, one may recognize that many of them are due to this capillary degeneration.

As a result of the thrombosis and destruction of the vessels, the infiltrated zones may be mottled, showing amid the cellular exudate lighter areas representing the degenerated capillaries. Moreover, when this

[1] *Jour. A. M. A.*, 1907, xlix, 462.

vascular degeneration is extensive, there is macroscopic necrosis of tissue on the exposed surface or in the center of the lesion. Hence the erosion of chancre, the desquamation of the syphilitic papule, the ulceration of the tuberculous syphilid, and the caseation of gumma.

Three types of cellular exudate may be distinguished, viz.:

1. The diffuse exudate caused by an acute, intense syphilitic infection in a soil of little resisting power. This is seen characteristically in the visceral lesions of hereditary syphilis. A whole lobe of liver or lung is infiltrated; there is practically no tendency to localization of the exudate or to central degeneration (gumma); all the vessels are involved.

2. The circumscribed, mild, multilocular exudate with no tendency to central degeneration, but with a marked tendency to spontaneous resolution. Such are the ephemeral lesions of secondary acquired syphilis.

3. The circumscribed, grave, malignant lesions of tertiary syphilis (whose characteristics are shared in a less degree by the chancre), of which the gumma is the type. These tertiary or gummatous lesions thus consist in dense perivascular exudates with central degeneration (caseation) due to vascular obstruction and obliteration in the periphery of the lesion.

The Pathology of Gumma.—The *subcutaneous gumma* is a deep-set syphilitic tubercle. At its onset it is simply a syphiloma, a localized perivascular granuloma, set in the subcutaneous tissue. But its center soon breaks down into a gelatinous or gummy mass (whence the name "gumma"). This central gummy mass consists of necrotic tissue held together by a network of fibrous connective tissue, so that even when the mass is large and completely disorganized it does not become absolutely fluid, but is kept in a characteristic semisolid state.

This mass, yellow or serosanguinolent in aspect, rapidly enlarges and bursts through the skin. Through the ulcer thus formed the gummy center comes away bit by bit, leaving a gummatous ulcer.

Gumma of the internal organs (liver, testicle, etc.) behaves somewhat differently. It begins as a granuloma and undergoes central degeneration, but it finds no outlet, and is limited in its spread by the change that occurs in its own outer layers. Here the inflammatory exudate changes gradually into scar tissue, which completely envelops the central gummy mass. In this fully developed state the visceral gumma therefore consists of a central gummy mass, surrounded by a dense envelope of fibrous tissue, which itself is infiltrated and surrounded by plasma and small round cells. Healing takes place either by absorption or by encapsulation of the gummy mass. The contraction of the fibrous tissue leaves a characteristic hard, puckered scar.

The *diffuse gumma* forms still another pathologic type, in which the

syphiloma is spread over a relatively large area, undergoes no central degeneration, and heals by complete transformation into scar tissue.

Lesions of the Larger Vessels.—Of the larger vessels the arteries are much the most commonly affected by syphilis, the veins less often, the lymphatics least of all.

The lesions are comparable to those of the capillaries—i. e., exudation into and about the vessel with obliteration and degeneration as its terminal stage.

The "coat-sleeve" infiltrate is seen about small vessels; but this systematic disposition of the exudate diminishes progressively in proportion to the size of the vessel attacked until, in the aorta, the lesions are usually patches distributed over the circumference of the artery, but showing no definite tendency to surround it.

The changes in the walls of the larger arteries are most common and have been best studied in the arteries of the brain. Whether these changes usually begin in the arterial intima, as Heubner, their discoverer, supposed, or in the adventitia, as is now generally believed, they spread around and along the vessel in the form of a round-cell exudate, usually involving the adventitia rather more than the intima, but in large measure sparing the muscular tissue of the media. Actual gummata may occur in the adventitia. Thus the wall of the vessel is thickened, its elasticity lessened, its intima congested and roughened. Hence in the smaller arteries the clinical result of syphilitic inflammation is usually thrombosis or obliteration, less often rupture or aneurysm, while in the aorta aneurysm is the usual clinical manifestation of the disease.[1]

[1] Symmers and Wallace, *Jour. A. M. A.*, 1916, lxvi, 397.

CHAPTER LXXXIII

THE COURSE OF SYPHILIS

THE ONSET

Although utterly irregular in its course, syphilis is practically always quite characteristic in its beginnings (at least in the male), and thus the diagnosis of syphilis is happily most readily made at the time when it is most necessary to make it.

Onset in Man.—Let us take, for example, a typical case in a man. He has intercourse on a given date (and may notice an abrasion upon the penis, or there may come out within the next few days a crop of herpetic vesicles. Yet in the great majority of instances neither of these things is noted). He thinks himself entirely normal and notices nothing wrong for a period of three to five weeks. Then he accidentally becomes aware that there is a single pimple upon the glans penis or upon the foreskin. This grows and becomes quite hard, and is eroded or ulcerated upon its surface. In a week or ten days the glands in one or both groins begin to swell, yet the sore itself and the glands are practically painless, and, as neither of them attains any great size, the patient may neglect to consult a physician. But, though relatively insignificant, the sore does not get well; the glands do not disappear. Three or four weeks go by and the ulceration upon the surface of the sore gradually heals, but a hard, typical lump remains under the epidermis. Then, in from two to three months from the time of infection, the first general symptoms appear.

At or before the onset of these the Wassermann reaction becomes positive.

First, he begins to feel a little miserable; his bones ache; he feels perhaps a little feverish, but probably not definitely sick, and may take no very great account of his malady until he notices a rash upon his body or some sore spots in the mouth or pharynx. These are pretty sure to bring him to the physician, who finds him with a characteristic macular, papular, or polymorphous eruption (to be described in detail later), with little sores in the mouth or pharynx, with disseminated, minute, scabbed ulcerations in the scalp, perhaps with a slight evening rise of temperature, and tender sternum and shins. He is in full secondary syphilis. The diagnosis is unmistakable.

Onset in Woman.—Such is the course followed by almost all men. In women the onset of the disease is by no means so characteristic. The chancre is so slight a lesion that it is usually overlooked by the patient, and she may fancy herself entirely well until, two or three months after infection, she begins to feel run down. She may have enough fever to fancy she has malaria, or she may be treated for an imaginary typhoid; or she may suffer from frightful pains in her bones, in her head, these pains coming on in the evening and much worse at night than during the day. A short while after the beginning of this outbreak of general toxemia she may show lesions of skin and mucous membrane quite as characteristic as those found in the male. But in a certain proportion of cases (9 per cent) these objective evidences are so faint as to be overlooked and, consequently, she does not present a typical and unmistakable picture of the disease. In such cases repeated miscarriages, or the birth of children that promptly die, may constitute the only characteristic early symptoms.

If the diagnosis is not made, her symptoms may gradually abate, and it may be years before a tertiary outbreak proves that she has syphilis. Or she may go on to have some characteristic lesion within a few weeks or months.

DURATION OF PRIMARY AND SECONDARY INCUBATION

Such is the beginning of syphilis as we see it clinically.

It may be divided into two periods: the primary incubation, ending with the appearance of the primary lesion—the chancre—and the secondary incubation, ending with the appearance of the secondary lesions.

The extreme limits of the various incubation periods are:

First incubation (inoculation to chancre) = ten days to six weeks.

Second incubation (appearance of chancre to secondaries) = within five months.

Total incubation (inoculation to secondaries) = one month to six months.

But if the patient actually has syphilis, it is rarely necessary to wait so long, for clinically the secondary incubation falls within three months in 94 per cent, and the total incubation within four months in 96 per cent of all cases.

The Wassermann reaction always becomes positive before the tenth week after the appearance of chancre.

What might be termed "the normal case" runs a primary incubation from two to five weeks, a secondary incubation from one to three months, a total incubation from six weeks to four months.

THE SECONDARY LESIONS

The secondary lesions, if anticipated by treatment, may never appear. Indeed, the early symptoms, both primary and secondary, are entirely overlooked in 1 per cent of men (22 out of 2,170 [1]) and in 9 per cent of women (18 out of 207).

Definition.—The secondary lesions of syphilis are twofold: an acute toxemia and certain local lesions varying in character from simple congestion to exudation. These local lesions are not destructive in character, do not invade the adjoining tissues, do not undergo caseation, and on healing leave little or no scar. They have usually a spontaneous tendency to heal.

Secondary Toxemia.—Examination of the blood during the first few months of syphilis, or at least until the disease is controlled by treatment, reveals a chloro-anemia. In the majority of cases in one's private practice this condition reveals itself but by one symptom: viz., loss of weight. One very frequently finds the syphilitic 10, 20, or even 30 pounds lighter at the end of six months than he was the day of his infection. This loss is gradually regained under treatment.

On the other hand, typical, severe, syphilitic toxemia with fever, prostration, and various pains, preceding the outbreak of the localized secondary symptoms, is so rare as to be almost always mistaken for malaria or typhoid fever until the eruptive lesions appear and establish the diagnosis, unless, as happened to a youth who came to me in the full glory of a general papular syphilid, it suggests measles.

The long-drawn-out debility, with loss of weight as its most striking symptom, is much more severe among women.

Local Lesions.—The first local secondary lesion appears on the skin in almost every case.

This first eruption is macular or maculopapular, and generally distributed over the trunk, less marked on the extremities. Exceptionally, it is preceded by a few scattered papules.

The Early Secondary Lesions.—But soon a whole group of lesions appears to form a characteristic picture of early syphilis. The body is covered with macules or papules; the scalp is full of moist crustaceous papules ("scabs," the patient calls them); there are pains in the joints, the bones, the muscles, the head; the mouth and throat are filled with mucous papules and erosions; the lymph nodes, especially the epitrochlear and posterior cervical, become enlarged, while the scar of the chancre with its satellite adenitis still marks the port of entry.

Such is the pathognomonic picture of secondary syphilis at its out-

[1] Personal statistics.

set. The picture lasts, in any or all of its constituents, from a week or two to a month or two.

The Subsequent Secondary Lesions.—After the subsidence of this first outbreak the occurrence of secondary symptoms follows no rule. Lesions of the skin and mucous membranes are likely to relapse, but at what intervals one cannot prophesy. A surprisingly large proportion of well-treated cases—perhaps three in five—have no further secondary symptoms. Relapses are most frequent in the first year.

Duration of Secondary Lesions.—While there is no absolute term to relapses of secondary lesions, no "secondary period" of syphilis, yet secondary lesions cease within the first four years in about 90 per cent of cases, within six or seven years in about 95 per cent. Secondary lesions appearing later than the tenth year are the rarest exceptions.

THE TERTIARY LESIONS

Definition.—Those lesions of syphilis which are localized and destructive of tissue are called tertiary. They consist of relatively diffuse infiltrations terminating in the production of masses of scar tissue or of relatively localized masses (gummata) tending to central caseation. The tertiary lesions show little tendency to heal spontaneously, but spread to the surrounding tissue, advancing in a circular or circinate way and destroying every tissue encountered in truly malignant fashion.

Occurrence.—The majority of cases of syphilis as we see it today do not have any tertiary lesions.

Tertiaries make their appearance more often in the second and third years of the disease than in any other two years; even in the first year they are by no means uncommon (6 per cent, Fournier; 13 per cent, Keyes). In half the cases they appear first within three (Keyes) to seven (Fournier) years after the chancre. The beginning may be deferred for an almost indefinite time. Among my cases the four longest deferred began at thirty (twice), thirty-one, and forty years.

Relapses.—The intermittent or relapsing character of syphilis is most evident in its tertiary lesions. Relapses of secondary lesions usually occur at relatively short intervals of a few months; tertiary relapses at longer intervals.

About one-third of my cases of tertiarism relapsed, and about half of these relapsing cases recurred no more after two years.

THE "PARASYPHILIDS" OR QUATERNARY LESIONS

Definition.—The parasyphilids or quaternary lesions are late manifestations of the disease (such as tabes, paresis, and aortic aneurysm)

the actual syphilitic nature of which has only been proven of late years. Clinically they are sclerotic and destructive in type and hence rebellious to treatment.

PROGNOSIS

The general prognosis of syphilis is a gloomy prospect compounded of various follies amid which madness for drink and carelessness in treatment stand pre-eminent. Yet intelligently treated syphilitics remain singularly free from grave relapses, a freedom which I believe they owe to the system of treatment followed, and constant insistence upon the fact that relapses can neither be foreseen nor absolutely prevented by any system of treatment. If the patient is made to recognize that he cannot be guaranteed against relapse in his own person (however sure he may be that he is no longer infectious) he is—sanely—on his guard.

In short, a case of syphilis intelligently treated and properly conducted usually terminates with the cessation of treatment at the end of three years in all things except the matrimonial guarantee, which is habitually to be reserved for two years longer.

What proportion of such cases are doomed to aortitis, myocarditis or syphilis of the nervous system can not be accurately estimated. My personal impression is that it is small. The present outcry [1] over these conditions is largely founded upon hospital observation of a class of patients who certainly are not likely to be cured in any sense.

The elements of the prognosis are:

1. The patient's constitution.
2. His environment.
3. His habits, chiefly as regards alcohol and tobacco.
4. His treatment.
5. The lapse of time.

THE PATIENT'S CONSTITUTION

In syphilis, as in any other disease, the most important element of prognosis is the way the patient *happens* to react to the infection.

But the effect of the constitution of the patient upon the course of the disease is by no means limited to the bald moderation or intensification of symptoms. Syphilis brings out every latent weakness. It encourages the development of tuberculosis. It plunges the hysterical and the neurasthene into new depths of despair. It feeds every organic neuropathic predisposition. On the other hand, the syphilis itself is colored by every tinge of heredity—diathesis and temperament alike.

[1] Cf. Warthin, *Am. Jour. Med. Sci.*, Oct., 1916.

The anemic or "scrofulous" victim suffers intensely from early toxemia, florid, general early skin lesions, and mucous membrane lesions of a most persistent relapsing character. The neuropath is stricken in his point of least resistance. Worst of all, "syphilis and civilization" are the cause of paresis and tabes. In short, syphilis assumes the habit of its victim. Its course depicts his weakness.

The recent suggestion that certain strains of spirochetes may have special affinity to the nervous system is interesting, but awaits final demonstration.

THE PATIENT'S ENVIRONMENT

Syphilis, like character, is founded upon heredity modified by environment. Every influence to which the patient is subjected may react upon his disease.

THE PATIENT'S HABITS

Since the patient's native immunity to syphilis is his most important asset, to fortify that immunity should be his constant effort. During the first years of the disease he should keep "in training." Regular hours, simple food, plenty of sleep, fresh air, and exercise should be his rule of life in so far as his position permits. A regard for the elementary rules of hygiene is always helpful, and is in some cases of syphilis as important as in tuberculosis. Unfortunately, many syphilitics grossly neglect the rules of hygiene, and yet come to no immediate, manifest harm. Consequently, they treat lightly the warning that bids them look to a more or less distant and problematical future; they neglect to make every effort to stamp out the disease while it is yet young, and in later years they return groaning under afflictions that were quite preventable.

Alcohol.—The reaction of alcohol upon syphilis epitomizes the effects of bad environment and evil habits. Alcohol is the commonest as well as the most active enemy of the syphilitic. Malignant early syphilis is most frequent among those who have been alcoholic, malignant late syphilis among those who remain alcoholic.

In debating the effect of alcoholism in syphilis a strict definition of the term is essential. By alcoholism is meant chronic intoxication by alcohol. This does not imply drunkenness. A man may die of alcoholism without ever being drunk. Indeed, the man who boasts that he cannot get drunk has the opportunity of becoming far more alcoholic than he who is laid low by a stein of beer; and it is precisely among these hardy and incessant drinkers that the most pronounced evil effects may be looked for. Persistent drinking may make it impossible to prevent or to cure tertiary relapses.

But the essential evil of alcoholism is not that it so often makes the

lesions of syphilis virulent and hard to cure, but that it, combined with inefficient treatment (and the two go hand in hand), is almost the whole cause of late syphilis.

Tobacco.—The ill effect of tobacco is immediate, local, and obvious. If it excites mouth lesions it must be stopped, but otherwise it may be used in moderation.

TIME AND TREATMENT

Time and treatment are the enemies of syphilis. Age certainly does wither her though time cannot be said to stale her infinite variety. If the disease relapses, appropriate treatment diminishes by fully 80 per cent the prospect of further relapse, though under this, as under any other geometric progression, an infinite number of relapses is possible.

It is believed that salvarsan administered during the primary stage cures syphilis. I hope that this is true.[1] Yet the one thing we really know about the ultimate results of salvarsan is that they are not all perfect.

MORTALITY

Life insurance statistics are the best foundation we have for estimating the mortality from syphilis, but we cannot estimate the degree of inaccuracy introduced by the fact that the least scarred patients are the most likely to lie about their previous history of syphilis. These statistics seem to show that the average expectation of life of the syphilitic insured is reduced five years, and that at least 15 per cent of syphilitics die as a result of their disease. Such deaths occur from 20 to 30 years after infection, i. e., between the fortieth and sixtieth year of life.[2] Matauschek and Piltz [3] analyzed the late results of syphilis among 4,000 Austrian army officers who had been infected from 12 to 22 years: 546 were dead (83 by suicide, 147 by tuberculosis, 17 by aneurysm, 101 by disease of the circulatory system, 71 of renal and 12 of hepatic disease, and 91 of disease of the nervous system). Of those remaining alive 198 had paresis, 113 tabes, and 132 cerebrospinal syphilis, of whom 80 were insane. They estimate that 14.64 per cent had died of the disease, or were chronic invalids as a result of it. It would be interesting in this connection to know what percentage of non-syphilitic Austrian army officers dies as a result of their manner of life.

[1] Boas (*Ugeskrift f. Laeger.*, Sept. 14, 1916) reports two carefully treated and inspected cases whose first secondary symptoms occurred in the second and third years after apparently successful abortive treatment with salvarsan and mercury.

[2] *Berlin. klin. Wochenschr.*, 1915, lii, 1057.

[3] *Med. Klin.*, 1913, ix, 1544.

CHAPTER LXXXIV

DIAGNOSIS OF SYPHILIS

MEANS OF DIAGNOSIS

The means of diagnosing syphilis may be classified as follows:

1. Laboratory Diagnosis.—Examination for spirochetes.
   Inoculation of monkeys.
   Specific reaction.
   Examination of the blood.
   Examination of syphilitic tissue (biopsy).
2. Clinical Diagnosis.—History.
   Scars of previous lesions.
   Appearance of the present lesion.
   Effect of treatment.

Laboratory Diagnosis.—Examination for Spirochetes.—The opinion of a *real* expert is valuable confirmatory testimony. But even the most expert may fail to find the spirochetes when present, and may think he sees it when absent. Hence such evidence is only confirmatory. I find it most useful in the differential diagnosis of chancre and of buccal sores.

Inoculation of Monkeys.—This can never be generally employed for lack of subjects. It appears to be a reliable test.

Specific Reactions.—Cf. p. 806.

Examination of Syphilitic Tissue.—A snipping from the lesion may differentiate gumma from neoplasm or tuberculosis.

Clinical Diagnosis.—Whereas the application of the laboratory tests is limited and bound to conform with the clinical findings, these latter are almost universally applicable. We are therefore much better acquainted with the limitations of our clinical tests, and in the present state of our art they are the more reliable.

Yet there is a sharp distinction between the method of applying these two classes of tests. The laboratory tests are applied singly; the success of one of them is almost as convincing as though they all coincided. But the clinical tests must be applied all together. History and scars give us a hint of what *may be* the trouble; this impression is

strengthened or weakened by the appearance of the lesion, and the laboratory tests, and *confirmed or refuted* by the effect of treatment. But if they fail to agree we may remain in doubt, and the lesion may heal and leave us there. For recovery under antisyphilitic treatment is no proof that the lesion was syphilitic.

Enlarged lymph glands are the exception rather than the rule in syphilis. Within two weeks after the appearance of chancre the typical inguinal adenitis appears, and lasts some three to six months. General syphilitic adenitis usually follows close upon the first general eruption, and disappears well within the year. Hence *syphilitic adenitis is extremely rare after the first year.*

DIAGNOSIS AT DIFFERENT PERIODS OF THE DISEASE

We may summarize here certain diagnostic situations that constantly come up.

The Initial Stage.—To diagnose syphilis by the appearance of a chancre one must find, not only the sore and the regional adenitis, but also spirochetes or a positive Wassermann reaction.

Unless the diagnosis is *absolutely* fortified by these precautions, one is not licensed to begin treatment until the Wassermann reaction becomes positive.

The Secondary Outbreak.—Various combinations of circumstances lead to a diagnosis at the time of the secondary outbreak. The positive Wassermann reaction, however, dominates the clinical scene.

In a Period of Calm.—Within the first six months typical posterior cervical and epitrochlear adenopathy are usually found. If both sets are enlarged and the patient's history is suggestive of syphilis, the chances are that the patient has the disease, and it is, therefore, safer for him to continue treatment than to stop it.

After the first six months there is often no trace whatever of the disease. In this event we must depend entirely upon the history, and, even though it be not very impressive, it is usually wiser to continue the treatment on the diagnosis previously given; for there are no means of proving that the patient has not syphilis, and the omission of treatment may bring him grave relapses in the future.

Later Relapses.—The diagnosis rests upon the Wassermann and spinal fluid tests and the characteristics of the lesion and its reaction to appropriate treatment. Negative laboratory findings should not weigh too heavily against positive clinical evidence.

Wassermann Test.—This is a great help as an adjunct in diagnosis at all stages of the disease. The provoked Wassermann should be freely employed.

CHAPTER LXXXV

TREATMENT OF SYPHILIS

PREVENTION

The prevention of syphilis is a moral as well as a hygienic problem. To the moralist it presents the problem of elevating the morals of the race so as to minimize the illicit sexual intercourse from which most venereal disease takes its rise. The hygienic problem includes the police problem of the suppression of prostitution, and the incarceration of infectious prostitutes and criminals until they are cured, the Health Board problem of abolishing the advertising quacks, providing free Wassermann diagnosis, and encouraging early and efficient treatment, and individual prophylaxis (which includes inunction of the penis immediately after sexual intercourse with calomel ointment and the diagnosis of all chancres by means of spirochete smears, and their prompt treatment by salvarsan).

Excision of the chancre does not abort syphilis, clinically or experimentally, in man or in monkey.

GENERAL PRINCIPLES OF TREATMENT

The old-fashioned treatment of syphilis has been completely swept to one side by the success of our newer methods of diagnosis and therapeutics. But we have exchanged for the danger of the disease itself dangers inherent in the remedies which we employ. The old-fashioned mercurial pill, if it controlled the disease little, retarded the reaction of the sufferer still less. But unintelligent employment of salvarsan may bring untold suffering to the patient by inducing the so-called neurorecidiv. In the modern treatment of syphilis the following three rules are fundamental:

Salvarsan is the most efficient specific for active lesions of syphilis, including the Wassermann reaction.

Mercury must be employed between courses of salvarsan for the purpose of preventing relapse of symptoms.

Hygiene is quite as indispensable under the new as under the old dispensation.

Salvarsan is infinitely more efficient than mercury in the control of active lesions of the disease, but salvarsan may perversely reduce the patient's resistance to the disease even more than it does the disease itself. While killing off what we may roughly term the great majority of spirochetes, it reduces the patient's resistance below what might be termed a normal par. Thus the patient is left with insufficient resistance to combat the spirochetes remaining in his body. The spirochetes in the nervous system are usually the ones to escape destruction, perhaps owing to their situation within the meninges. Hence a few months after the administration of salvarsan the patient is likely to suffer a neurorecidiv, i. e., a relapse of syphilis in the nervous system. This relapse is most likely to occur after the administration of salvarsan during the first year of the disease; but it is occasionally seen later on, and there is good reason to believe that some cases of syphilis moderately well controlled by mercury, although they may be brilliantly cured by salvarsan, relapse rather more viciously after this than they did before its use. Let us hasten to add, however, that salvarsan will even cure the relapse excited by the salvarsan.

On the other hand, mercury can claim no such parasiticidal qualities. It destroys the spirochetes little by little or, if they have already been destroyed by salvarsan, it continues the action of that drug and fortifies the sufferer against the relapse that would otherwise ensue. For this purpose it is not sufficient to give pills. A stronger remedy is required, and this is provided either by inunctions or injections of mercury. These should be given before as well as after the salvarsan.

TREATMENT OF SYPHILIS IN THE PRIMARY STAGE[1]

If the chancre is diagnosed before the Wassermann reaction becomes positive, six injections of salvarsan should be given at intervals of from five to seven days. Gennerich considers this sufficient to sterilize the patient; I prefer to continue the treatment as though the reaction had been positive. (See footnote on p. 820.)

If the Wassermann is positive before treatment is begun or becomes positive after the first or second injection the six salvarsan injections are usually enough to render it negative. Treatment is then continued by injections or inunctions of mercury for at least one year (as in the treatment of secondary syphilis), and the cure confirmed by negative Wassermann reactions every six months for at least two years thereafter.

[1] *N. Y. State Med. Jour.*, 1915, xv, 425.

TREATMENT OF SECONDARY SYPHILIS

All authorities are agreed that a prompt cure may not be expected. The six injections of salvarsan are preceded as well as followed by the usual intensive mercurial course of four or five injections. The Wassermann reaction is taken irrespective of treatment every six months, and the courses of mercurial injections are kept up as follows:

If insoluble mercury is used a course consists of an injection every fifth to seventh day until six or eight injections have been given. The courses are repeated in this way with an intermission of a month between each throughout the first year. Four courses of injections are given in the second year, two in the third year. At the end of that time it is wise to give two salvarsan injections as a provocative in order to search the cure and to *examine the spinal fluid,* for if it is then negative the central nervous system may probably be guaranteed free from danger. For two years longer the Wassermann reaction is taken every six months. If it has remained negative throughout this time, the patient may be dismissed as cured—with the usual reservation that an absolute guarantee is impossible.

Soluble mercurial injections and inunctions are given in similar courses, each course of twenty to thirty daily treatments.

TREATMENT OF THE LATER LESIONS

Later lesions are treated in a similar manner. Courses of from four to six injections of salvarsan being employed for the purpose of relieving symptoms or of making the Wassermann reaction negative, and the patient is thereafter fortified by a treatment with mercurial injection for at least two years, though it is customary to give only four courses of injections in each year instead of six courses in the first year as in the treatment of secondary syphilis.

If the Wassermann reaction does not become negative, or the lesions do not yield, special stress must be laid upon hygiene and the courses of salvarsan repeated not more than twice a year. If the blood Wassermann reaction is rebellious to four such courses, and the spinal fluid shows no disease in the nervous system, even Ehrlich himself has advised that one desist from further treatment. I have followed one case with a fixed positive Wassermann for seven years, yet his Wassermann remains positive and he remains perfectly well.

TREATMENT OF SYPHILIS IN THE NERVOUS SYSTEM

Many lesions of the nervous system yield to the routine treatment described above. We are just now in the midst of a crusade which has for its object the elimination, not only of symptoms of nervous disease, but also of the pathologic changes in the cerebrospinal fluid by the administration of drugs directly into the cerebrospinal space. Sufficient time has not elapsed for judgment to be passed upon this treatment, but the following rules may be laid down:

1. The Swift-Ellis salvarsanized serum treatment is probably much the safest of the various methods employed.

2. Even this treatment is uncomfortable, requires hospital confinement, sometimes results in paralysis of the bladder and bowel and of the lower extremities, and even in death: hence it should only be employed by an expert neurologist or serologist.

3. The treatment has proven quite efficacious in rebellious cases of tabes, but its efficacy in developed paresis is still doubtful.

SALVARSAN

Salvarsan or "606" is to be preferred to neosalvarsan. The latter is estimated to be one-quarter as efficient as the former. But it is safer for administration by the house staff, since infiltration of the tissues with neosalvarsan does not produce the sloughing which infiltration with old salvarsan most emphatically does.

Intramuscular Injections.—The original methods of intramuscular injection of salvarsan were fantastically cruel. They left the patient writhing in pain for a week or two after the injection. American drug houses are putting out suspensions of salvarsan in various oily media for intramuscular injection in doses of about 1 decigram each. I have never employed the drug in this manner, and should judge from the experience of the army [1] that repeated intravenous injections are likely to prove much more efficient than repeated intramuscular injections. The intramuscular injections, as at present employed, are given in much the same manner as injections of mercury, in interrupted courses.

Intravenous Injections.—On account of the deaths resulting from the intravenous administration of salvarsan this has been surrounded by a number of rather fantastic requirements. Thus it is insisted that the glass in which the solution is mixed shall be alkali-free, and that the water shall be both distilled and boiled; and it is promised that as the result of such precautions no mishaps will occur. I always em-

[1] *Surgeon-General's Bul.*, No. 3, June, 1913.

ploy distilled and boiled water; I have never used an alkali-free glass bottle. I cannot say that my mishaps are any fewer since I used distilled water than they were when the water was simply boiled. The original technic calls for the administration of 300 c.c. of fluid. At present the usual allowance is 10 c.c. of distilled water for every decigram of the drug to be injected.

The dose for an adult male is 3 to 4 decigrams; for an adult woman, 3 decigrams; for an infant, 1 centigram.

The bend of the elbow is sterilized, and a tourniquet applied above it so as to distend the veins while the patient holds his elbow stiff and his hand tightly clenched. Meanwhile the distilled water is warmed to about blood heat and a tube of salvarsan emptied into a glass-stoppered bottle containing 30 c.c. of this warm water. This is violently agitated for some minutes until the salvarsan is thoroughly dissolved, even the glass-like sticky particles having disappeared. To this is added, drop by drop, a 15 per cent solution of chemically pure sodium hydrate. With the second or third drop the solution becomes cloudy, with the fifth or sixth it becomes clear. Only enough sodium hydrate should be added to absolutely clarify the solution. If some particles remain in suspension they may be cleared by filtration through a sterile cotton filter.

The injection is made either by gravity or with a 30 c.c. piston syringe, or by a syringe to which is attached a three-way stop-cock, and one rubber tube leading into the bottle containing the salvarsan while another leads to the needle in the patient's arm. Whatever the method employed it is essential that the salvarsan be given slowly and that at least five and preferably ten minutes be taken for the injection of the 30 c.c. Therefore the gravity method is the safest.

It is further absolutely essential that the needle be actually in the lumen of the vein when the injection is given. If the solution is injected into the cellular tissue about the vein a frightful slough will result, the patient will have an incapacitated arm for from three to six months, and a permanently disfiguring scar thereafter.

Immediate Accidents.—The patient should always be lying down when the injection is given, but even so he may get quite a sharp immediate reaction, shown first by a reddening of the skin, a sense of fullness in the head, and of rapid heart-beat followed by a faintness with great pain in the epigastrium and loin. During this period the pulse becomes almost imperceptible and the patient is in a condition of severe shock. This anaphylactic reaction is said to be most common after the second injection. It may, however, be averted by injection under the skin at the first sign of flushing of the patient's face of 10 minims of 1:1,000 solution of adrenalin. This injection should not be made intravenously.

Toxic Results.—Patients have died following the injection of salvarsan of acute encephalitis and of acute congestion of the kidney. The latter is by far the most common cause of death, and is an accident that cannot perhaps be wholly avoided, though the injection of salvarsan should always be preceded by a careful examination of the kidney and urine. If this is abnormal and contains albumin and casts and shows a deficient excretion of urea, the salvarsan should only be given in $\frac{1}{3}$ or $\frac{1}{4}$ of the usual dose. I have lost one patient by acute nephritis; he died anuric and jaundiced on the fourteenth day after his second injection of 3 decigrams. I have lost but one other case, who died apparently of pulmonary embolism just after I had given him his sixth injection. (His syphilitic lesion was a hemiplegia due to rupture of a blood vessel at the base of his brain.) As compared with these extremely rare fatalities (which are said to occur once in five thousand cases) one not uncommonly sees evidences of mild intoxication following the injection of even small doses of salvarsan. About half the cases have a slight rise of temperature from one to four hours after the injection. This rise is occasionally sharp enough to be accompanied by a violent chill and fever. By the end of an hour all is approximately normal again. At about this same period the patient may be seized with violent projectile vomiting and diarrhea or this may come on the following day. It usually lasts for an hour or so but may last for several days. A few days after the injection of salvarsan it is not uncommon for the patient to show erythema, urticaria, coryza, sore throat, indigestion, or diarrhea; evidences grouped as anaphylactic.

In the early days of salvarsan administration optic neuritis frequently resulted from the use of wood alcohol as a solvent for the drug. Since optic neuritis was known to result from the administration of Fowler's solution and atoxyl the lesion was erroneously attributed to the arsenic. But with the elimination of wood alcohol from the solution optic neuritis is scarcely mentioned, except as a neurorecidiv. I have seen the complication but once (a week after the third injection of 3 decigrams to a patient with chancre. It disappeared within a month.)

Neurorecidiv and Other Relapses.—The chancre redux (falsely interpreted as a second attack of syphilis), relapse of syphilis in the nervous system (usually in the form of deafness or facial paralysis), and other relapses of the disease, occurring usually from three to six months after the administration of salvarsan, are perhaps the most discouraging of the many complications of salvarsan therapy. Such relapses are most frequent when the drug is administered in the first six months of the disease (the Wassermann reaction usually remaining negative). They can apparently be prevented by the preliminary and subsequent "guardian" mercurial injections.

Later in the disease it will be noted that symptoms of cerebrospinal

lesions, especially the mental symptoms of paresis, may be aggravated by salvarsan, especially if unguarded by mercury.

It must be further confessed that salvarsan sometimes exhibits this curious stimulating effect upon syphilitic relapses even more remotely and obscurely. While the majority of cases derive nothing but benefit from the drug a certain few seem to show a vicious tendency to relapse after salvarsan. The vigor of salvarsan therapy at the present day will soon determine the clinical significance of such cases.

Contra-indications.—There are no absolute contra-indications to the use of salvarsan. Grave visceral disease contra-indicates large doses of this, as of any other drug. Renal complications are of the most importance, for Wechselman [1] maintains that hemorrhagic encephalitis is due to nephritis. He believes, however, that this nephritis is mercurial in origin and argues that mercury should be abandoned and syphilis be treated exclusively by salvarsan. At the present writing, however, the opposite theory prevails, the many complications of salvarsan therapy having produced a revulsion in favor of mercury. Indeed, it will doubtless require many years of clinical experience thoroughly to thrash out the question of the relative contra-indications to salvarsan. It has quite fallen from its high estate as sovereign remedy. Many lesions can unquestionably be controlled without it. Only the ultimate outcome of the cases now being treated by salvarsan can decide its true value.

At present it must be employed always in the primary period and for the cure of lesions that mercury fails to control, especially the persistently positive Wassermann reaction. It may be used in all cases, if guarded by mercury; but with what ultimate effect we do not know.

It is especially questionable whether provocative salvarsan injection does not sometimes provoke real activity in a dormant syphilis.

MERCURY

The great disagreement that exists in the profession today concerning the mercurial treatment of syphilis is founded essentially upon the great variation in the virulence of syphilis, especially its early virulence. Some cases of the disease do perfectly well for the first few years without any treatment at all, so well, indeed, that their condition may pass unrecognized. Others do equally well on treatment that consists solely of the administration of mercurial pills and solutions of potassium iodid. But many cases are not controlled by these drugs even during the first years of the disease. Such cases demonstrate the efficiency of salvarsan and of mercury administered intramuscularly

[1] "Ueber der Pathogenese d. Salvarsans-todes-faelle," Berlin, 1914.

or by inunction. These methods of treatment promptly control lesions that had long been rebellious to internal treatment.

On the other hand, the contemplation of the late lesions of syphilis shows that the mild internal treatment leaves much to be desired. Tabes and paresis occur almost exclusively in patients whose treatment would seem totally inefficient according to our modern standard. Visceral syphilis, notably syphilis of the liver, the heart, and the aorta, is the heritage of the present generation from the "pill and potash" of the preceding one.

It is not yet proven that the most intensive treatment will, in the long run, cure or even control syphilis. But this intensive treatment, as far as mercury is concerned, has been employed for at least a decade in this country and for a generation in Europe. Controlled by the blood Wassermann reaction and the spinal fluid reactions and aided by the brilliant immediate efficiency of salvarsan, there is every reason to predict that the next generation will inherit from us a far smaller toll of syphilitic cripples.

But even were this not the case it is imperative, as already stated, that the violence of salvarsan be matched with the violence of mercury by injection or inunction. If this is not done the patient may, within a year or so be in a worse state than if salvarsan had not been employed.

For these reasons we deplore treatment by pills and prefer to ignore this method of administering mercury.

TOXICOLOGY OF MERCURY

Salivation.—Salivation is the commonest form of mercurial poisoning. It may occur from the use of mercury under any form.

Symptoms of Mild Salivation.—The first symptom noted by the patient is a *coppery taste* in the mouth. This is accompanied by a very heavy *disagreeable odor* to the breath; the *tongue and cheeks become edematous* and show the marks of the teeth; the *gums bleed;* the *teeth feel sore* and elongated.

Examination of the gums reveals localized areas of congestion, *especially about the lower incisors* or about any decayed tooth. When the lesions are more pronounced the gums actually ulcerate. The *pathognomonic mercurial ulceration appears behind the lower incisors and back of the lower wisdom teeth.* Ulcerations may occur elsewhere in the mouth, and it may be almost impossible to distinguish the lesions due to the medicine from those caused by the disease.

Actual *salivation* is usually slight at first, though in some cases the excessive flow of saliva is the earliest symptom.

Symptoms of Severe Salivation.—Nowadays one does not see

"good, old-fashioned" salivation, the patient depressed, feverish, stupid, his tongue swollen beyond recognition and gangrenous in spots, a constant stream of ropy saliva drooling from his swollen lips, his teeth loosened and falling, even his jaws becoming necrotic, and his breath permeating the atmosphere with an intensely disgusting fetid odor.

Treatment of Salivation.—So important is the care of the mouth in the *prophylaxis of salivation* that the patient about to take a course of mercury should be carefully instructed how to keep his mouth in good condition.

He must first have his teeth filled and thoroughly cleaned by a dentist.

He must brush his teeth morning and night.

He must smoke little.[1]

He must report the instant his gums become swollen or sore—at which time mercury must be suspended.

The *treatment of mild salivation* consists in painting the gums with one of the following solutions:

℞ Tr. myrrh.,
Tr. iodi comp., ... āā ʒj (4 gm.).
Aquae,

S.—Apply to gums once or twice a day.

Or

℞ Acid lactic ..... ʒj (4 gm.).
Aquae ..... ʒij (8 gm.).

S.—Apply to gums once a day (Tennesson).

Almkvist[2] states that salivation is due to sulphid of hydrogen about the teeth roots, resulting from bacterial action upon the mercury. He praises the injection of strong (20 per cent) peroxid of hydrogen between tooth and gum.

Meanwhile, let the patient suck during the day two or three tablets (āā gr. v) of chlorate of potash.

The bowels must be kept open (they are usually loose, anyway) and the *mercury stopped.*

For severe cases, free purging and diuresis, hot baths, a milk diet, and *suspension of the mercury* constitute the most important treatment. The local applications may be used as in mild cases. Ulceration of the cheeks may be lessened by separating them from the teeth with pledgets of cotton dipped in boric acid solution or with a piece of raw turnip.

[1] I am not sure that the irritation of tobacco is an important contributory cause of salivation, but I know it predisposes the patient to syphilitic mouth lesions.

[2] *Hygiea,* Aug. 15, 1915.

Enterocolitis.—A sharp diarrhea with colic usually accompanies severe salivation.

To prevent this is the art of managing mercury.

To cure it stop the mercury, put the patient on a fluid diet without milk, and, after giving a sharp purge, administer bismuth (gr. x), beta-naphthol bismuth (gr. x), or opium.

Mild cases are promptly relieved by stopping the mercury.

Nephritis.—The normal kidney secretes mercury in small doses perfectly kindly. But mercury may produce congestion of the kidney or nephritis either:

1. When the kidneys are diseased, or
2. When mercury is given in poisonous dose.

Any form of acute or chronic nephritis makes the kidneys a poor filter for mercury, and since mercurial nephritis is the rarest form of mercurial poisoning, there is always room for suspicion that the kidney is chiefly at fault. This is further emphasized by the fact that there occurs an acute secondary syphilitic nephritis which may be mistaken for mercurial nephritis.

The chief practical point in regard to nephritis is that *the urine should be examined when mercurial treatment is instituted, and should be repeatedly examined during any severe course of mercury.*

Albuminuria or nephritis does not contra-indicate the administration of mercury, but does give warning that it must be given in small doses and with constant attention to the condition of the renal function.

Dermatitis.—Some skins are very sensitive to inunction, and in general the hairy portions of the skin become irritated most readily.

Mercurial dermatitis begins as an erythema which, in severe cases, goes on to an acute eczematous condition (mercurial eczema).

There is also an extremely rare dermatitis, due to a peculiar individual susceptibility to the internal administration of mercury. The eruption is scattered, erythematous, urticarial, or eczematous. It burns or itches; in fact, is a typical toxic eruption. Though said to be commonest after internal administration, the only case I have seen was a sharp urticaria following injection.

The *treatment* consists in stopping the mercury (for a time, and then using it in small doses), soothing lotions, and catharsis.

Ill-effects of Prolonged Mercurialization.—Mercury can be given quite indefinitely in nontoxic doses. But prolonged courses, even if only moderately severe, produce emaciation, anemia, and general vital deterioration, such as would ensue upon any chronic poisoning.

If the medication has been much prolonged, or extremely severe, the patient may be left with chronic nephritis or gastro-enteritis, from which he will never recover.

INTRAMUSCULAR INJECTIONS

Preparations Used.—The preparations of mercury employed for injections are either soluble or insoluble. The chief *soluble preparations* are the bichlorid and the biniodid.

The chief *insoluble preparations* are the salicylate, gray oil, and calomel.

Bichlorid.—This salt is used in 1 per cent or 2 per cent solution with salt solution, various quantities of salt being used by different authorities. The following is an excellent combination:

℞ Hydrarg. chlorid. corrosiv..... gr. xv-xxx (1-2 gm.);
Sodii chlorid. ..... gr. x (0.6 gm.);
Aquae destillat. ..... ʒiij (100 c.c.).
Dose: 1 c.c. (♏ xv).

Biniodid.—The red iodid of mercury is employed either in oily solution or in so-called "serum" or mixed with potassium iodid. It appears under various proprietary names. I have employed cypridol, the Hannam's and Lafay's sera. These preparations are popular on the Continent, but are little used here. I prefer the following:

℞ Hydrarg. biniodid. ..... ʒss (2 gm.);
Potass. iodid. ..... gr. xv (1 gm.);
Aquae destillat. ..... ad ʒiij (100 c.c.)

Among the soluble preparations the succinamidate (1 cgm. dose) and the sozoiodolate are well spoken of, though the latter is apparently soon reduced to biniodid.

Salicylate.—This may be put up in 5 per cent or 10 per cent strength. The mixture I employ is:

℞ Hydrarg. salicylate ..... gr. xlviij (3 gm.);
Albolin (sterilized) ..... ʒj (30 gm.).
Shake.—Dose: ♏ x (0.7 c.c.).

The salicylate settles to the bottom and has to be distributed by vigorous shaking. The admixture of a little lanolin makes a better suspension but a thicker mixture.

Gray Oil.—Gray oil is an emulsion of metallic mercury.

The formula I employ is that of Lafay:

℞ Hydrarg. bidestillat.[1]..... ʒijss (10 gm.);
Albolin ..... ʒiij (13.5 gm.);
Lanolin ..... ʒjss (46.5 gm.).
Shake.—Dose: ♏ ij-vj (0.1 to 0.4 c.c.).

[1] This is the "dentists' mercury."

Calomel.—Calomel oil is made by pulverizing the drug, washing in boiling alcohol, drying in an oven, and then thoroughly mixing with ten parts of sterilized albolin. Dose: 0.5 c.c.

Method of Administration.—*The soluble salts may be given subcutaneously,* but this method is unnecessarily painful. They are best given—and *the insoluble preparation must be given—into the substance of some thick muscle.* Injection of an insoluble preparation subcutaneously invites abscess or gangrene.

The *site* usually selected for injection is the buttock. The pectoral muscles or the thick muscles of the interscapular region or loin may also be utilized. Successive injections are given on alternating sides, and no two injections should be put within an inch of each other on the same side.

The best points for injection are in the region bounded below by a line joining the top of the intergluteal fold with the top of the trochanter; above by a line joining the anterior superior spine with the sacroiliac synchondrosis; and limited to the central region of the buttock, keeping three fingers' breadths away from the median line and from the line of the femoral shaft projected upward.

The implements are a sterilizable hypodermic syringe (preferably all glass, as metal instruments are amalgamated by mercury), and a needle two inches long and of ample caliber; for very stout persons the needle should be two and a half inches long.

Technic.—Boil the implements, wash your hands, and, making the patient lie upon his face, rub the buttock well with alcohol.

Then, having filled the syringe and attached the needle, plunge this up to the hilt in the appointed spot and inject. Then withdraw the needle and briskly rub the subcutaneous fat so as to obliterate its track.

Bleeding is readily controlled by pressure and adhesive plaster.

Dosage.—It will be found that any of these preparations may be given to certain patients in very high doses.

But equally good results, nay, better ones, may be obtained by the ordinary doses given above, and *an apparent toleration on the part of the patient should never tempt us to excessive hypodermic medication.* I know no rule more important than this, for excessive medication by injection produces a distinctly cumulative effect. The mercury continues to be absorbed for many days after its injection, and I have several times seen *severe and prolonged salivation begin in the second or third week following cessation of treatment by insoluble injections,* and continue for many weeks thereafter.

The choice between soluble and insoluble injections is largely a matter of taste. Both have their champions for the routine as well as for the symptomatic treatment of syphilis. *None of these injections is absolutely painless* (despite what their votaries say to the contrary),

and, since soluble injections have to be given every day for a "course" of ten to thirty injections, the pain caused by them is cumulative, and in the end may be less tolerable than the more severe but less often repeated pain from insoluble injections.

A more important distinction is this: *Insoluble injections are the more efficient,* and, since efficiency is the one claim made in favor of injections, this fact is gradually forcing insoluble injections to the fore.

On the other hand, we have to consider the relatively grave accidents that may result from insoluble injections.

Disadvantages of Injections.—Soluble.—The disadvantages of *soluble injections* are the cumulative pain, the relative inefficiency, and the necessity for daily visits to the physician.

Insoluble.—The disadvantages of *insoluble injections* are general and local.

The *general disadvantages of insoluble injections* are poisoning and embolism.

Acute mercurial poisoning may follow within twenty-four hours of a single injection of mercury. It is characterized by cramps, explosive diarrhea, depression of spirits, even fever; it may last several days. If the usual doses are employed such an attack follows the first injection once in every thirty or forty cases. It is not prohibitive. Lessen the dose at the next injection, and thereafter return to the full dose.

Grave salivation follows any overdose with mercury, but that following injections of insoluble mercury has two very annoying characteristics: It is slow to appear and slow to disappear.

Embolism.—The embolism is almost always pulmonary; its symptoms may appear the day after injection, though they usually follow it immediately.

After a more or less marked premonitory stage of slight fever and malaise, the attack begins with a sharp pain in the side, which interferes greatly with respiration. The temperature and pulse rise; the patient is much prostrated. The physical signs are those of a circumscribed pneumonia. The whole attack lasts from a few hours to a week.

The frequency of embolism is estimated at about one in a thousand injections. I have had but five in my practice and my father one; this in several thousand injections.[1] One or two fatal cases of mercurial embolism have been reported.

The *local disadvantages of insoluble injections* are pain, induration, abscess, sloughing.

[1] It has been alleged that the danger of embolism may be averted by disengaging the needle before injecting and noting whether the free flow of blood from it shows its point to be in a vein. But I have deliberately tested this method in the clinic, and got no embolism from six cases that bled, though we did get an embolism from one that bled not a drop.

The *pain* varies greatly. Soluble injections are painful for one to three days; during this time they may cause agony. Insoluble injections give no immediate pain unless a nerve is actually punctured by the needle; but in from six to twenty-four hours the spot begins to ache, and this ache increases for a day or two longer, then gradually diminishes, but may last ten days or more.

The first injection is likely to hurt more than subsequent ones, but no two of them are alike. One may set up an intense sciatica, lasting a week, and the next one be almost painless. Some persons feel the pain much more than others. Indeed, it is practically prohibitive in certain cases.

Indurations may occur even from insoluble injections. I have had a patient come to me with both buttocks a solid indurated mass from injections of bichlorid.

Abscess and gangrene are due to dirt or carelessness. Neither accident has occurred in my practice.

INUNCTION

Preparations Employed.—The *official blue ointment* (ung. hydrargyri) can be improved by the substitution of one of the proprietary ointment bases. These are less greasy and odoriferous. Put up in capsules (one for each rub) they are convenient to carry about.

Another new preparation is *calomelol ointment,* white in color, in graduated glass tubes, two of the "marks" to be used for each rub. It is cleaner than the blue ointment, and seems to be about as efficient and somewhat less irritating.

The Technic.—The best method is that employed at the Hot Springs. The patient takes a hot soap-and-water bath, is well rubbed down with alcohol, and then is ready for his inunction. He sits astraddle a chair with his face toward the back, his arms folded upon it and his chin resting upon his arms. An attendant now rubs in broadly and with a vigorous circular motion of the hand over the entire back a given quantity of mercurial ointment, generally one dram at a rub. The friction continues for twenty minutes. (To prevent mercurialization the frictioner may protect his hand with a rubber glove.) The ointment thus rubbed in is left upon the back, and the patient puts on first a thin gauze undershirt (which he wears a week as a "mercurial" shirt), and over this his ordinary undershirt and customary clothing. On the following day the patient takes another hot soap-and-water bath, is thoroughly washed, rubbed with alcohol, and then takes another friction as on the previous day, resuming his mercurial shirt.

In case the patient has to do his own rubbing he cannot reach his

back, and as no other part of the body is covered with skin sufficiently thick to bear daily rubs, he is obliged to shift from place to place. The hot bath, the alcohol rub, and the mercurial shirt are employed as in the above-described system, and the rubs are made in the following regions on successive days:

1. Right arm and forearm, internal aspect.
2. Left arm and forearm, internal aspect.
3. Right thigh.
4. Left thigh.
5. Right side of thorax and loin.
6. Left side of thorax and loin.
7. Abdomen.

The purpose in thus distributing the course is to make it occupy an even week. Hairy subjects may have to modify the plan.

The ointment must be rubbed into the skin until every bit of greasiness has disappeared. This takes about twenty minutes, and is a duty the patient is inclined to shirk.

Merits of Inunctions.—In efficacy inunction ranks below injection. In convenience it may rank higher, in that it can be performed by the patient himself. But the dosage is uncertain, for we do not know how much mercury is absorbed by the skin (indeed, it may not be absorbed at all[1]), and very few patients rub in the ointment thoroughly.

But the chief objection to inunction comes from the patient. The treatment is dirty and disgusting; it often irritates the skin, and may even provoke a local eczema.

For these reasons a patient when asked to choose between inunction and injection almost invariably selects the latter. And unless he is oversensitive to injections, I much prefer he should.

THE IODIDS

Salvarsan has eliminated potassium iodid from the treatment of syphilis. The drug is still employed, but everything that it can do in the relief of pain and in the conquest of tertiary lesions of syphilis is so much better done by salvarsan that its effects and defects scarcely seem worth enumerating.

HYGIENE

The hygiene of the syphilitic is precisely that of the tuberculous patient. Each is a chronic disease controllable chiefly by virtue of the patient's own reaction. That we possess an array of specific drugs

[1] Cf. Hay, *Jour. A. M. A.*, 1909, liii, 674.

for the treatment of syphilis is no excuse for utterly neglecting the patient's health. Especially brilliant results may be obtained in the treatment of syphilis by taking advantage of the intervals between courses of the specific drugs to administer "milk and sunshine." The syphilitic infant is never overweight. The tabetic is always thin. The prognosis of syphilis may sometimes be as accurately estimated in terms of pounds gained or lost as in terms of the Wassermann reaction.

CHAPTER LXXXVI

THE INITIAL LESION

The *initial lesion* (primary lesion) *of syphilis consists of the chancre and the adjacent adenitis.* It must not be forgotten that the inflamed lymph glands form as essential and characteristic a part of the initial lesion as does the chancre itself.

THE CHANCRE

The chancre is an eroded or ulcerated, painless neoplasm, arising at the site of syphilitic inoculation.

The chancre is primarily a neoplasm. By bearing this in mind we distinguish it instinctively from chancroid, which is primarily an ulcer. The one is a lump, the other a hole.

This neoplasm is commonly called the *induration.* The induration may be very extensive; it may form a large hard lump, projecting markedly above the surrounding tissues and having a diameter of perhaps an inch. But usually (in eight cases out of ten) it is small—one might almost say minute—and instead of projecting above the integument it is embedded in it. Thus, it may be felt rather than seen, and in appearance is rather insignificant than impressive.

The surface of this insignificant neoplasm is almost always eroded and moist, but it may be ulcerated, or it may be covered by an unbroken reddened integument.

It is *peculiarly hard and elastic,* as though a piece of cardboard were embedded in the integument. In order to appreciate this one must pick it up from the surrounding tissues and palpate it from side to side.

Pathology.—The chancre has the general characteristics of syphiloma. We find in a connective-tissue framework a mass of plasma cells, leukocytes—all the elements of an acute localized exudative inflammation. The vessels, especially the arteries, are infiltrated, irregularly thickened, and occluded by the characteristic "coat-sleeve" infiltration. The surface of growth is more or less necrotic, whence the erosion or ulceration. Proper staining shows spirochetes in the substance of the chancre.

This inflammation diminishes insensibly toward the border of the induration and extends into the surrounding tissue far beyond the apparent limits of the growth. The infiltrations in the vessel walls, in particular, extend beyond the palpable seat of the disease. Yet the depth of the chancre is almost nil. It occupies chiefly the epidermal layer of the skin, encroaching but little on the true derma and the subjacent tissue. Hence it leaves no scar.

Multiple Chancres.—The most striking characteristic of chancre is its insignificance; next in order of importance is its uniqueness. Yet too much stress may be laid upon this. The chancre is usually single, to be sure, yet Papagaey,[1] who collected 14,004 reported cases, found that in from 25 per cent to 33 per cent the chancres were multiple. This confirms other Continental statistics; yet multiple chancres are certainly much fewer in my practice. My records show only 56 among 549 cases examined—i. e., 1 in 10.

But whether 1 in 10 or 1 in 3, the multiple chancre must be counted with, and *it is a grave clinical error to insist on the uniqueness of chancre as a diagnostic factor.*

The *number* of multiple chancres is 2 in 78 per cent of cases (Papagaey). My father has recorded 1 case of 11 and 1 of 12 chancres (4 on the left breast, 8 on the right). Fournier has seen a patient with 23 (7 on the left breast, 16 on the right).

The *location* of multiple chancres is almost exclusively genital. Only 2 per cent of extragenital chancres are multiple (Fournier). Chancres of the breast are quite frequently multiple.

The existence of multiple chancres brings up the question, When does syphilitic immunity begin? Is reinoculation possible?

Although in many instances the several inoculations are indubitably simultaneous, in others they doubtless succeed one another, perhaps after an interval of several days. Indeed, Queyrat[2] has proven that *it is sometimes possible to auto-inoculate chancre* if the inoculation is performed before the lesion is ten days old, and experimental inoculation bears this out.

Types of Chancre.—The three chief types of chancre are:

1. The eroded chancre.
2. The ulcerated chancre.
3. The indurated papule.

The Eroded Chancre.—From 60 to 80 per cent of chancres assume this form. It is most characteristically exemplified by chancres within the preputial cavity.

The *induration* is rounded, *circumscribed,* and *thin,* sometimes so thin as to be scarcely perceptible except to the most delicate touch

[1] *La syphilis,* 1906, iv, 64.

[2] *Bull. de la soc. Franc., de derm. et de syph.,* 1906, vol. xvii, p. 66.

(parchment chancre). Exceptionally the parchment chancre ulcerates deeply.

Its *color* is usually a dark, vinous, or "raw-meat" red. Rarely it is of a dusty gray color (the color of lard). It may be covered with little petechiae.

Its *surface* is usually flat. It may be a little elevated above the surrounding integument, or a trifle sunken below it, or surrounded by a slightly elevated ring of induration.

The eroded surface is smooth and polished. It emits a *slight seropurulent discharge.* It may be covered by a crust or a false membrane (from infection by skin cocci).

FIG. 192.—LARGE ULCERATED HUNTERIAN CHANCRE. (Kaposi.)

THE ULCERATED CHANCRE.—This is the type of chancre described by Hunter, and to it the title "hunterian chancre" is, therefore, peculiarly applicable. It is far less common than the eroded chancre.

It has a relatively large indurated base topped by a distinct ulcer. The ulcer is due to extensive necrosis, and the necrosis is proportional to the interference with circulation; thus the thinner induration forms an eroded chancre, while the more nodular mass ulcerates.

The ulcer extends into the true derma. Its edges are sloping (not undermined) and give the sore a sort of funnel shape; the base is granulating and may be covered by a false membrane; the discharge is slight and serosanguinolent.

The clinical picture of ulcerated chancre is that of a neoplasm eaten out by an ulcer, not that of an ulcer surrounded by an inflammatory ring. The neoplasm may be embedded within the skin; but pick it up, and you will realize that it is a distinct lump with an ulcer in the center.

THE INDURATED PAPULE.—This is the rarest type of chancre. It occurs usually in situations where the integument is so dense and thick as to prevent very extensive development of the neoplasm. The induration consequently remains a small, dark-red, flat papule. As it begins to heal the surface becomes scaly.

EXCEPTIONAL VARIETIES.—The induration may be so slight as to be clinically imperceptible. Fournier noted this *absence of induration* 7 times in 300 cases.

As a result the lesion appears to be either:

1. A superficial herpetiform ulceration or group of ulcerations (herpetiform chancre), or

2. A grayish or silver-white spot of thickened epithelium. This is seen only on the glans penis.

Both these types are extremely rare.

On the other hand, the *induration* may be very *extensive,* and extend far beyond the ulceration.

Complications of Chancre.—The chief complications of chancre are:

1. Lymphangitis and edema.
2. Chancroid (mixed sore).
3. Simple inflammation.
4. Phagedena (gangrene).
5. Transformation into a mucous papule.
6. Vegetations.

Lymphangitis.—Corded lymphatics, running from the chancre to the adjacent glands (e. g., along the dorsum of the penis), are not often seen.

But in certain localities, such as the prepuce and the labia majora, a great mass of lymphatic induration may surround the chancre, or small similar masses may lie adjacent. Such a complication obstructs the lymphatic flow and causes considerable edema. It is sometimes spoken of as indurative edema.

"Mixed" Sore.—As chancroid itself is rare among the upper classes, so is the mixed sore, the combination of chancroid and chancre. Among the chancres seen in the dispensary, however, fully one-third are "mixed sores."

The possible combinations of chancre and chancroid are three:

1. The chancroid may appear, flourish, and be cured, and from its remains the chancre may arise.

2. The chancroid may overlap and overshadow the chancre, so that the latter is suspected only from the induration remaining after the sore heals, or proven by the appearance of secondary syphilitic lesions, or a positive Wassermann reaction.

3. A true chancre may become chancroidal.

Of the three types, the second is the one commonly observed. The presence of chancre is not even suspected until the chancroid in healing begins to take on a suspicious hardness, or until a roseola breaks out all over the patient. *While the patient has an active chancroid, therefore, one can never assure him he has not true chancre.*

Inflamed Chancre.—The friction of clothes, or any other form of trauma, may so irritate the chancre that it becomes acutely inflamed: yet this is unusual. As a rule, the pyogenic microbes have no effect upon chancre beyond encouraging ulceration.

Gangrenous and Phagedenic Chancre.—The obstruction to circulation in the indurated base of a chancre is habitually sufficient to excite desquamation and exudation from its surface. Exceptionally, it is so marked as to cause *gangrene* of the dermis. Such a complication is of no great importance. Phagedena is far rarer. Indeed, *the occurrence of phagedena is presumptive evidence that the sore is not chancre.* It is probably gumma.

Transformation into a Mucous Papule.—Chancre upon the mucous membrane or between moist folds of skin may, at the time of the first, general, secondary outbreak, become a typical mucous papule. The fact requires no further comment.

Vegetations.—Soft warts may surround the chancre. Their presence is accidental, and can scarcely be called a complication.

Duration.—The chancre usually lasts four to six weeks, though some trace of induration may remain many months.

Reinduration of the chancre, which simply means recurrence of syphilitic inflammation in a chancre partially or wholly cicatrized, may prolong its duration indefinitely.

Fournier relates that he has seen a chancre run its whole course in two weeks. This must be about the minimum. Yet patients will often say that their chancres only lasted a few days, for they are careless observers. Their testimony merely bears witness to the clinical insignificance and painlessness of this lesion so fraught with grave consequences.

Diagnosis.—During the first week of a chancre spirochetes may readily be found in its secretion (p. 803). During the ensuing weeks they become less numerous here but may often be obtained by aspiration of the inguinal glands. The Wassermann reaction often becomes positive in the second or third week, almost always in the fifth week, and always between the eighth and the tenth week following the appearance of the chancre.

Treatment.—A daily wash with warm water, protection from friction of the clothes, and the application of any simple dusting powder is all the treatment the chancre needs.

But the disease requires instant and energetic specific treatment.

THE ADENITIS OF CHANCRE

Syphilitic inflammation of the group of lymph glands adjacent to the chancre is part of the initial lesion. It is as constant and typical as the chancre itself. Indeed, Fournier failed to find it only thrice in 5,000 cases. It appears in the second week after the outbreak of the sore.

Inguinal adenitis may be bilateral or unilateral; if the latter, it is usually on the side corresponding to the chancre. Exceptionally the lymphatics so anastomose that the adenitis is on the opposite side (*crossed bubo*). As a rule, however, both sides are affected.

Symptoms.—The adenitis appears in the second week after the appearance of the chancre, usually on or about the tenth day. It reaches maturity in two or three days, and presents the following characteristics: multiplicity, moderate size, absence of peri-adenitis and of all acute inflammation, hardness, slow resolution.

Multiplicity.—There is always a group of glands involved; indeed, inguinal adenitis usually shows involvement of a group in each groin, but the one rather more enlarged than the other.

This group, or pleiad, as Ricord appropriately termed it, is made up of one (rarely more) large gland surrounded by a group of lesser ones (clinically the large node often predominates the scene, the lesser ones being scarcely discernible).

Size.—The larger gland scarcely attains the size of a cherry and may be much smaller; the lesser ones are the size of peas.

Absence of Inflammation.—Unless there is mixed infection the glands are neither painful nor tender. They are freely movable beneath the skin, upon the subjacent parts, and upon one another.[1] The skin over them is not discolored; they do not suppurate. This *complete absence of peri-adenitis* is one of their most striking characteristics.

Hardness.—"The hardness of the glands is the hardness of the chancre;" such is the routine statement. The clinical facts do not quite bear it out. Though the glands may be as hard as the chancre, and when so are typical, in the larger number of cases they are distinctly more elastic.

Slow Resolution.—The great virtue of syphilitic bubo is that it persists many weeks after the chancre has disappeared and may lead to the discovery of the scar of a healed chancre. It usually persists three months.

Unusual Varieties.—The bubo may be abnormal, inflamed, or "mixed."

Abnormal Bubo.—Exceptionally the bubo consists of a single very large gland, or the large gland is altogether lacking.

Inflamed Bubo.—Inflamed bubo is much more common than inflamed chancre. The pyogenic bacteria multiply upon the chancre and from it enter the lymph current, yet may not cause much local irritation. The common clinical causes of inflamed bubo are genital filth and cohabitation.

The bubo of labial or buccal chancre is habitually a large, tender, inflamed mass.

[1] Unless they are inflamed, in which case they adhere to one another.

"Mixed" Bubo.—Syphilitic adenitis may be complicated by chancroid or by tuberculosis.

Chancroid and chancre combine to make a "mixed" sore and a "mixed" bubo. In both instances the characteristics of the chancroid lesion overshadow the other.

Tuberculosyphilitic glands I have never seen. They are said to assume the tuberculous type.

Diagnosis.—The typical group of one large uninflamed gland surrounded by a lot of little ones—all of them hard, insensitive, and not adherent—is so unmistakable that a discussion of its differentiating characteristics is all but superfluous.

Certain varieties of herpes or balanitis excite a bubo quite similar to that of syphilis; but the exciting lesion is so dissimilar that a mistake is scarcely possible.

The insensitive, hard, movable glands of syphilis can scarcely be confused with the inflamed, tender, adherent nodes of chancroid; though, as we have already said, the latter may conceal the former.

The diagnosis is certified by the discovery of spirochetes or by the Wassermann reaction.

CHAPTER LXXXVII

SYPHILIS OF THE SKIN: GENERAL CHARACTERISTICS; SECONDARY SYPHILIDS—SECONDARY SYPHILIS OF THE MUCOUS MEMBRANE

SYPHILIS OF THE SKIN

Syphilitic skin lesions are marked by certain general characteristics that serve to identify them from other similar nonsyphilitic lesions. The diagnosis of any given syphilid is founded largely on these characteristics.

GENERAL CLINICAL CHARACTERISTICS

1. Progressive development.
2. Polymorphism.
3. Absence of local or general inflammatory reaction.
4. Absence of pain and itching.
5. Peculiar raw-ham color.
6. Rounded form.
7. Scales white, superficial, nonadherent.
8. Crusts greenish or black, thick, irregular, adherent.
9. Ulcerations rounded or circinate, with abrupt edges, sanious secretion, and sluggish base.
10. Scars round, depressed, thin, nonadherent, smooth, often pigmented.
11. Early eruptions disseminated and profuse, later ones asymmetrical and grouped.

Progressive Development.—With various degrees of speed, but, as a rule, slowly and gradually, the eruption spreads. The superficial general eruption spreads by the appearance of new lesions; the later single lesions by encroaching on the surrounding tissues.

Polymorphism.—The early, general eruption develops progressively in type as well as in multiplicity of lesions. Thus a general, papular eruption a week old may show macules, papules, tubercles, vesicles, pustules, and minute ulcers irregularly intermingled. Such is polymorphism. It is all but pathognomonic of syphilis.

The later the eruption the less polymorphic it is likely to be.

Absence of Inflammation.—Fever very rarely accompanies a syphi-

litic eruption. Exceptions, chiefly due to absorption from mixed infection of a pustular syphilid, are so few as to be negligible.

Neither is tenderness, heat, nor inflammatory congestion discernible in the lesion itself.

Absence of Pain and Itching.—The syphilitic lesion as such is painless. In those exceptional instances (and they are singularly rare) of mixed infection with the ordinary pyogenic microbes, the pain is due to the adventitious inflammation.

Moreover, the syphilid does not itch. A little tingling may accompany the relatively rapid development of a diffuse exanthem, but even this is rare and does not amount to a real itch.

Peculiar Color.—The color of the syphilids is not a frank, inflammatory red, but a vinous, empurpled redness, resembling, when well marked, the raw meat of ham. This color is found also in many of the gouty, papular eruptions and in psoriasis, rarely in other eruptions. The color of the syphilids passes by pigmentation from this dusky red into a yellowish copper color, and sometimes by a deep pigmentation to brown or black, the skin around the lesion (areola) being usually also pigmented to a certain extent. This pigmentary coloration sometimes lingers for years, but usually clears off after a few months, disappearing first centrally, then peripherally. Finally, the spot becomes brilliantly white.

Rounded Form.—Every syphilid is composed of circular lesions. If discrete, as in most of the earlier eruptions, the individual lesions are manifestly round. But many of the later lesions are confluent. Either because the lesions begin so close together or because in spreading they invade the same territory, the resultant lesion is a composite one, and this may show a *circinate,* polycyclic edge, which is very characteristic.

Moreover, although the disposition of the first general eruptions is diffuse and irregular (though symmetrical), *the lesions composing later eruptions are often distributed in circles* or in segments of circles.

Finally, certain of the more chronic syphilids as they progress extend in every direction toward the periphery, healing at the same time in the center. Hence result lesions of a circular or circinate or horseshoe shape quite pathognomonic. Such eruptions are called serpiginous.

The Scale.—The scales on the cicatrices and on the patches of scaly, syphilitic eruptions are thin, white, nonadherent, lamellar; they are very different from the dense, thick, imbricated, adherent scales of psoriasis.

The Crust.—The scabs formed on syphilitic ulcerative, rupial, and pustular lesions are rough and adherent, dark brown, or greenish black, sometimes loosened by an underlying accumulation of pus, but more

often seemingly set into the skin, and tightly adherent. They may be of light color over secondary pustular lesions, but whether light or dark, the green hue is rarely totally absent and is often brilliantly marked.

The Ulceration.—With the exception of the chancre and of the ulcerated mucous papule (both of which may vegetate and are usually elevated rather than depressed), the ulcerations of syphilis resemble chronic, indolent ulcers. They are rounded or oval, with abrupt edges cut away like those of a chancroid; the base is covered with yellowish, false membrane, sometimes bluish, like boiled sago. The edges and base of the ulcer are usually hard, and the former generally, but not invariably, firmly adherent and not undermined, as in the ulcerations of tuberculosis. These ulcers do not bleed easily, are generally atonic and sluggish, and usually entirely painless. Apparent exceptions to the rule in regard to pain are often due to the dependent position or other cause calculated to excite inflammation, or to the situation of the ulcer over a bone, the periosteum of which is inflamed and painful.

The Scar.—The cicatrices of such syphilitic lesions as have destroyed tissue (i. e., tertiary lesions), whether there has been surface ulceration or not, are rounded, very thin,[1] depressed, smooth, shining, and nonadherent. They are *often at first uniformly pigmented* of a dark-brown hue (nearly black in brunettes). This pigment clears off from the center to the circumference until only a dark border is left, which sometimes lasts for years, but finally the whole cicatrix acquires an almost pearly whiteness (though the pigmentation may persist indefinitely).

General Clinical Characteristics of Secondary and Tertiary Syphilids

Certain general clinical characteristics distinguish the secondary from the tertiary syphilids.

The *secondary lesions* are:

1. Superficial, benign, resolutive.
2. Multiple, profuse, or even generalized.
3. Irregularly disseminated, but usually symmetrical.
4. Polymorphous.

The *tertiary lesions* are:

1. Deep, destructive, and malignant.
2. Few in number, often single.
3. Distributed in circles or segments of circles, and usually asymmetrical.
4. Usually monomorphous.

[1] Marked only with the slightest irregularities (like cigarette paper).

Secondary Syphilids

The secondary syphilids affecting the general integument may be discussed under the following heads:

Macular syphilids.
Papular syphilids.
Syphilitic alopecia.

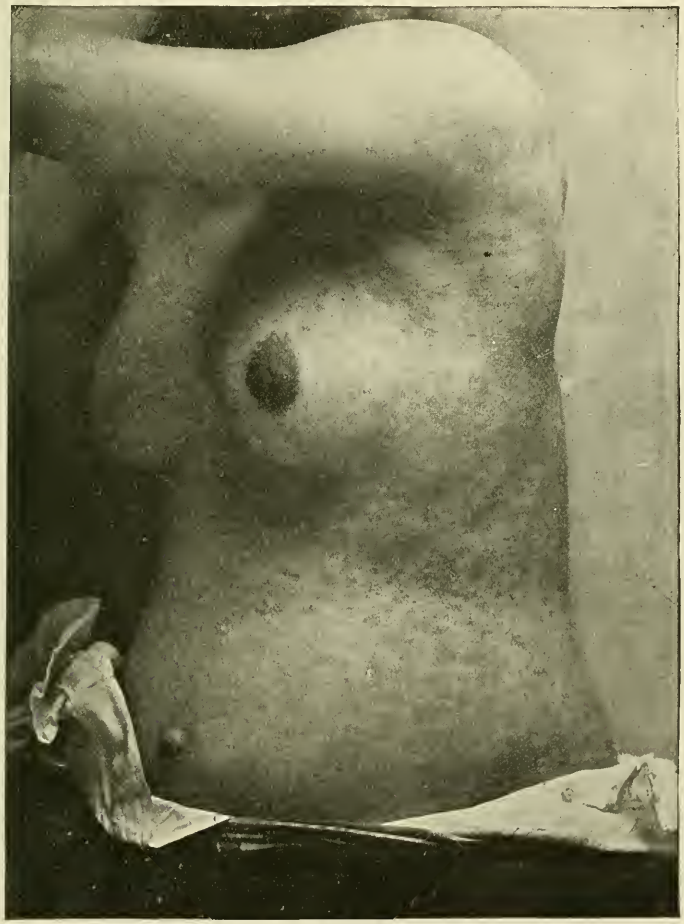

Fig. 193.—Macular Syphilids. (Fox.)

Pustular syphilids (including crusted and ulcerating lesions).
Squamous syphilids.
Pigmentary syphilids.

Macular Syphilid.—General Macular Syphilid.—This eruption, often called the syphilitic roseola, is usually the first secondary eruption of the disease. It is made up of macules of various sizes. It is

usually most marked on the flanks; may cover the whole body; is extremely rare on the face and hands. If untreated, it disappears in two to six weeks.

Late, Circinate, Macular Syphilid.—Relapses of macular syphilid assume a distinctly circinate form; it is, as it were, the shadow of a circinate tuberculous lesion.

The Papular Syphilids.—The Papule.—The syphilitic papule is very slightly elevated above the surface of the skin. It varies from the

Fig. 194.—Papular Syphilid; Confluent on Face.

size of the head of a pin to that of a split pea. Its summit is flat, though, if the papule be very small, this feature may be lacking. Its shape is absolutely and characteristically circular; its color, at first pink, soon takes on a purplish, ham, or copper hue, although quite frequently this is not marked, but may be intensified by pressure. Its surface is shining and tense, and this may be covered by a slight, thin scale, or, more commonly, this scale is promptly shed, leaving a faint,

scaly collar around its base. The papule is hard, and has in some measure the induration characteristic of all syphilitic exudates. From the papule all the other elements of secondary skin syphilis arise, and in the earlier, papular eruptions, it is not uncommon to find admixtures of pustules, squamous papules, etc.

Papular Eruptions.—The papular syphilid may be general and disseminated or partial and scattered. In a certain proportion of cases the general macular or papular eruption is preceded by the appearance of a few scattered papules. As a rule, however, the first papular eruption is generalized.

Relapsing papular eruptions tend to be more closely confined to certain (indeterminate) regions the later they occur. As a rule, however, the papules are not grouped in any geometric figure; they remain disseminated. Even those later papular eruptions are often bilateral and symmetrical.

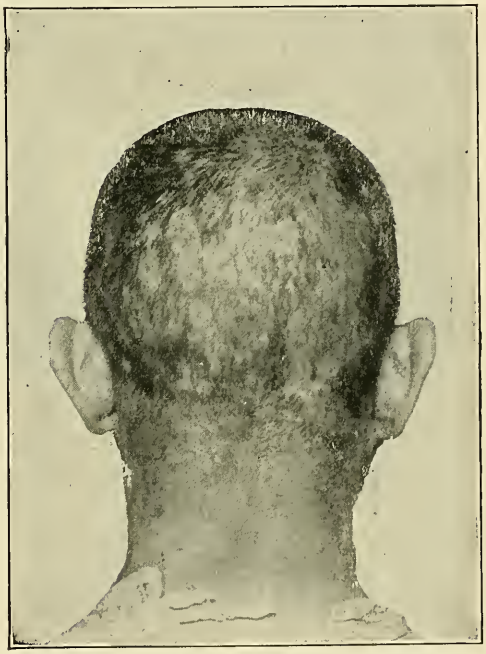

Fig. 195.—Syphilitic Alopecia. (Pusey.)

Syphilitic Alopecia. — Alopecia is not a common feature of syphilis. A general falling of the hair may accompany the first outbreak of the disease; but this is noticeable only to the patient himself. Much more characteristic but quite rare is the "moth-eaten poll" illustrated in Fig. 195. These types of alopecia are temporary. Syphilis does not cause true baldness.

The Pustular and Crusted Syphilids.—The pustular syphilids are all (excepting the crusts in the scalp) rare secondary lesions. Pustulation is, generally speaking, excited by dirt and debility. It is, therefore, properly regarded as an evil omen.

The pustule is, as it were, superadded to a syphilitic papule and sits upon it, destroying but little tissue, and hence leaving little or no scar. Pustular lesions may be scattered among the papules of a polymorphic eruption, but the more notable pustular eruptions are those which follow given types and mimic certain nonsyphilitic eruptions. Accordingly we distinguish:

Herpetiform syphilid.

Varicelloid (or varioloid) syphilid.
Acneiform syphilid.
Impetiginous syphilid.
Ecthymatous syphilid.

The titles sufficiently describe them.

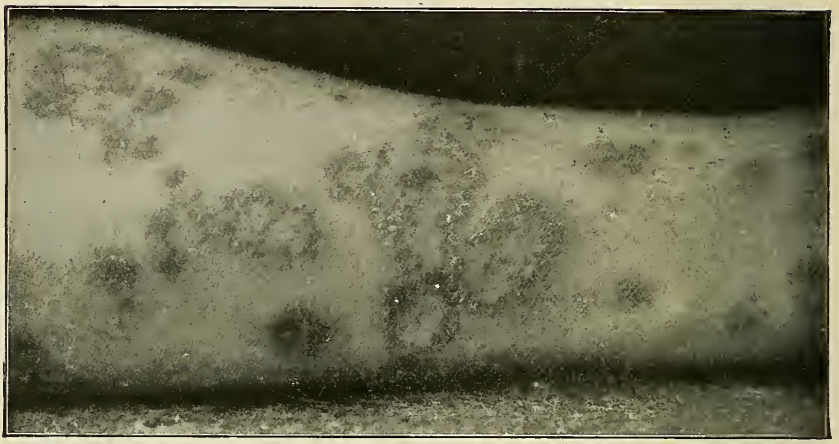

Fig. 196.—Circinate Papulosquamous Syphilid on Forearm. (Fordyce.)

The Squamous Syphilids.—Generalized Squamous Syphilid.—This eruption occurs in two varieties—as a guttate or diffuse psoriasis and as a circinate eruption. The character of the eruption is the same in each. They may be seen together on the same subject.

Diagnosis.—When not associated with other specific lesions, the squamous syphilid is often difficult to distinguish from *psoriasis.* Much

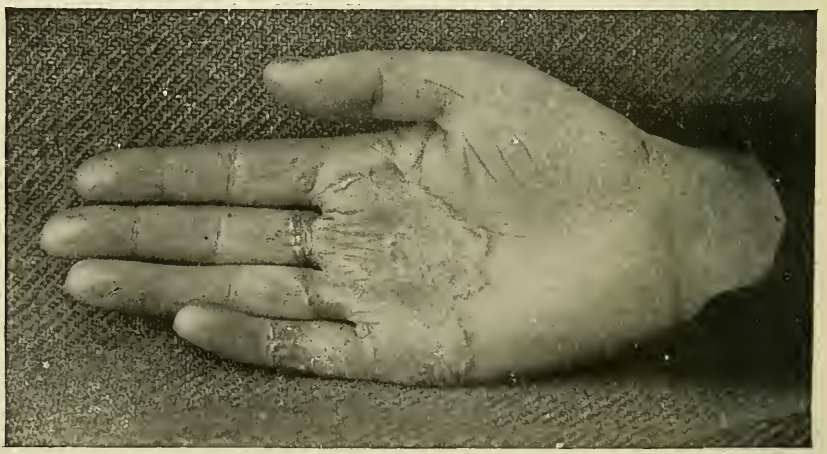

Fig. 197.—Squamous Syphilid of Palm. Note circinate border and absence of definite papules. (Fordyce.)

light is thrown upon such cases by study of the previous history. Psoriasis tends to cluster about the elbows and knees and upon the scalp, and practically *never affects the palms and soles;* its scales are thick, imbricated, tightly attached, and lying in several layers, so that it is difficult to scrape them all away and get down to the livid redness of the patch beneath; and when the scales all rudely rubbed off the patch is very apt to bleed.

Squamous Plantar and Palmar Syphilid.—If the eruption is seen when it first comes out, its papular quality may be readily recognized in the manifest, individual papules or in the sinuous line of confluent papules. But in an aged lesion, even if it be only a few months old, the papules may almost entirely disappear, and all that is left visible is the squamous almost scarlike change.

In this condition the eruption may continue active and spreading in a circinate way for many years, during which time an occasional papule may become visible, or the confluent red ribbon may show itself here and there. But the general characteristic of the eruption is a purely scaly one. The scales follow one of two types. In the more common form they produce glistening psoriatic or eczematous-looking spots. Less often and almost exclusively on the feet they heap up in a great callus.

The Pigmentary Syphilid.—This extremely rare eruption usually appears as a reticular brownish patch upon the neck. It is extremely slow to disappear.

SECONDARY SYPHILIS OF THE MUCOUS MEMBRANES

Distribution.—They may affect any part of the mucous membranes and also any part of the skin which in texture and moisture simulates the physical conditions of mucous membrane. They are commonest in the mouth and throat and in and about the genitals.

Etiology.—Local irritation is the exciting cause. In the mouth the local irritation of tobacco, whether smoked or chewed, stands pre-eminent. About the folds of the skin uncleanliness excites them. In the male they are more common in the mouth than elsewhere; in the female, much more common about the genitals on account of the profuse secretions there.

Classification.—The secondary syphilids of the mucous membranes may be classified as follows:

1. Macular syphilid.
2. Erosive or papulo-erosive syphilid (mucous papule).
3. Ulcerative syphilid.
4. Squamous syphilid.

5. Smooth atrophy of the base of the tongue.

Of these, the macular syphilid is unimportant. The erosive papular and ulcerative types are common in the first year of the disease and occur infrequently for several years thereafter, while the squamous types are rarely seen before the second or third year, and may continue indefinitely thereafter.

The Erosive or Papular Syphilid.—The syphilitic papule upon a moist skin or mucous membrane surface is always eroded. Even upon a dry surface it sheds the superficial epithelium, and, when kept moist, the deeper layers are more freely exposed and exudation from the surface of the papule is thus a constant phenomenon in all papular lesions of mucous or moist surfaces.

The early erosive papular lesion may be so slight as to produce no perceptible irregularity in the surface. Its top is level with the surrounding mucous membrane, but it is an eroded top, and, consequently, the papule appears as a simple erosion. In a second type the papule is elevated above the surface to a slight degree and becomes a typical, eroded papule, while in the third type it is hypertrophic and becomes a vegetating papule or condyloma. Hence the three types of erosive papular syphilids:

The erosion.

The eroded papule.

The vegetating papule or condyloma.

The Condyloma.—The striking characteristic of this lesion is that, though a vegetating one, the vegetation is relatively low compared to the extent of a base; hence, it is commonly known as *condyloma latum.* Its foul secretion, its irregular, broken, vegetating, and eroded red surface constitute amplifications of the characteristics of the eroded papule.

The Ulcerative Syphilid.—Just as the papule may appear as a simple erosion, an irritated papule, or a hypertrophied papule, so the ulcer may appear as a *simple ulcer,* as an *ulcerated papule,* or as an *ulcerated hypertrophied papule.*

Leukoplakia.—By leukoplakia (tylosis, milk spot, etc.) is meant a chronic inflammation of the mucous membrane characterized by the appearance of pearly-white or bluish-white patches. These patches may appear anywhere inside the mouth, but, while extremely common upon the tongue, they are very rare elsewhere. I have record of only seven cases occurring on the tongue thickened by sclerotic glossitis, or (rarely) destroyed by gumma.

Prognosis.—Leukoplakia is one of the most inveterate lesions of syphilis. Cases lasting four or five years are not uncommon, and one occasionally sees them continue for ten or twenty.

The most important question in the prognosis of leukoplakia is the

occurrence of *epithelioma.* Most authors speak of it as common. But among my cases I have known only two to undergo epitheliomatous change.

Smooth Atrophy of the Base of the Tongue.—This lesion, first classified by Virchow, is due to destruction of the lymphoid follicles of the base of the tongue. It is a very common autopsy finding (Symmers [1]) and can be identified clinically as a smoothness of that part of the tongue immediately in front of the epiglottis.

Diagnosis.—I know no pathognomonic characteristic to distinguish the ulcer of syphilis from that of mercury, but the latter rarely occurs upon the fauces or upon the dorsum of the tongue or in the angle of the lips, where syphilitic ulcers are common; while *it is almost typical of mercurial ulceration to find a lesion on the cheek or gum back of the last molar tooth, or between the upper or lower central incisors.*

Vincent's angina may be mistaken for either a primary or a secondary syphilitic mouth lesion. The microscope makes the diagnosis.

Treatment.—Local Treatment of Lesions upon the Skin.—If the lesion is upon the skin it is usually possible to keep it dry, and this drying will cure *erosion or vegetation* as if by magic. In mild cases all that is necessary is to cleanse the affected region thoroughly twice a day with warm soap and water, then dry and apply pure calomel or calomel mixed in equal parts of stearate of zinc or talcum.

For extensive condylomata it may be necessary to paint with a solution of permanganate of potash (1: 1,000) twice a day and to interpose a layer of absorbent gauze between the various inflamed surfaces after powdering the whole region thickly, until salvarsan effects a cure.

Local Treatment of Lesions within the Mouth.—The local treatment is mild cauterization, and the best cauterizing agent is the officinal *liquor hydrargyri nitratis,* either pure or diluted to one-half or one-quarter strength. The pure fluid can be applied only to small lesions, as it is quite painful. *This application should be made not oftener than once a week,* and should never be confided to the hands of the patient, since overcauterization makes the lesion worse instead of better.

In order to prevent relapses of secondary syphilids within the mouth, it is often necessary for the patient—

To stop smoking and chewing tobacco;

To keep the teeth and gums in perfect condition.

[1] *Am. Jour. Med. Sci.,* Dec., 1910.

CHAPTER LXXXVIII

TERTIARY SYPHILIDS OF THE SKIN AND UPPER RESPIRATORY TRACT

The syphilitic tubercle is to tertiary skin syphilis what the papule is to secondary skin syphilis.

The pathological difference between papule and tubercle consists in this: The papule is an exudation rather *upon* than *in* the true skin. It does not destroy any of the tissue of the skin, therefore it does not leave a scar. The tubercle, on the other hand, is an exudation within the derma which, upon healing, leaves a permanent scar.

Tertiary syphilids of the skin are made up of various tubercular, tuberculopustular, tuberculo-ulcerative lesions, and of gummatous lesions. "The tubercle may be described as a gumma of the skin, and, conversely, the gumma as a deep tubercle of the connective tissue" (Morrow).

Thus tertiary syphilids may be divided as follows:

Tubercular lesions.

Tuberculo-ulcerative lesions, and

Subcutaneous gummata.

TERTIARY SYPHILIDS OF THE SKIN

THE TUBERCULAR SYPHILID

The nonulcerative, tubercular syphilid occurs under two forms:

The disseminated tubercular syphilid, and

The grouped tubercular syphilid.

Either of these may be scaly upon the surface (tuberculosquamous).

The tubercles are usually small. Their favorite positions are on the forehead (circle of Venus), the lips, the back, the leg, the outer surface of the forearm, and the back of the shoulders. A single tubercle may constitute the whole eruption, or there may be great numbers of them.

Grouped Tubercular Syphilid.—The favorite locations for the grouped lesions are those just mentioned.

The grouping occurs in three forms:

1. The discrete form.

2. The confluent, circinate form (Fig. 198).
3. The massed form.

If *discrete,* the tubercles appear to be ranged in circles or in arcs

Fig. 198.—Confluent Tubercular Syphilid of Nose. (Fox.)

of circles, forming a polycyclic or circular design. If *confluent,* they form sinuous scalloped figures, or else a solid, rounded, indurated *mass.*

THE ULCERATIVE TUBERCULAR SYPHILID

The tertiary ulcerative skin lesions have certain characteristics in common:

1. *The individual tubercles are quite large.*

2. *They may become serpiginous;* that is to say, the ulcers and tubercles creep over the surface. The advance may be centrifugal in all directions or along a narrow track in curves, inclosing portions of healthy skin; or the advance takes place in only one direction, while the opposite edge of the ulcer is cicatrizing.

Thus the *serpiginous ulcer* is usually a flat plane of scar tissue more or less completely surrounded by a ditch of ulceration set in an indurated syphilid as a base.

FIG. 199.—SERPIGINOUS TUBERCULO-ULCERATIVE SYPHILID. (FOX.)

3. *They may be phagedenic.* Phagedena is malignant, rapidly spreading gangrene.

It may spread chiefly over the surface (superficial phagedena); or may eat its way deeply into the underlying tissues (deep phagedena).

The course of phagedena is most capricious. Even when untreated its rapid spread will suddenly stop and the slough will be cast off

and the lesion go on to heal; or, having stopped, it may take a new start.

Characteristics of the Lesion.—The ulcerative tubercular syphilid may appear clinically as a *pustular,* a *crusted,* or an *ulcerating* lesion. Pustules are infrequent and rapidly break to take on one of the other types. Whether the lesion is crusted or ulcerated depends largely upon

Fig. 200.—Gummatous Ulcer; Tibial Node. (Fordyce.)

the accident of its situation. Usually it will be found covered with a typical syphilitic scab; but if it has recently been picked or if it lies in some place subjected to constant friction, the scab may be off and a typical syphilitic ulcer disclosed.

Thus the lesion may appear in one of the following forms (we give only the most important ones, since they are useful merely for clinical identification):

Tertiary ecthyma.

Rupia.
Other forms of crusted syphilids.
The ulcerated syphilid.

SUBCUTANEOUS GUMMA

The gumma begins as an insensitive, little, hard subcutaneous lump, freely movable over the subjacent tissues, the integument slightly movable over it. In this condition it may remain stationary for months, but, as a rule, it grows slowly in size, and within a few weeks has infiltrated the skin.

The skin becomes red and tense, then, as the gumma begins to soften centrally, purple, boggy, and *tender to pressure.* Actual fluctuation may be determined and may cover quite a large area. As the tenderness continues, and may even be accompanied by intense pain, incision is often practiced to relieve these symptoms. The result is startling. Instead of a gush of pus there oozes forth only a few drops of bloody or purulent serum; the fluctuation persists; the symptoms are unabated; the incision has merely produced a gummatous ulcer.

The gummatous ulcer resembles the ulcerated tubercle, but it is deeper and its base is more sloughy.

Diagnosis.—Gumma may be mistaken for varicose ulcer of the leg.

SYPHILITIC LEG ULCER	VARICOSE LEG ULCER
1. *Situation.* — Anywhere. Often in calf or in upper half of leg.	1. Only in lower third of leg. Habitually on internal surface.
2. *Number.*—Often multiple.	2. Rarely multiple.
3. *Shape.*—Round or polycyclic.	3. Irregular.
4. *Edges.*—Sharp, deep, or even undermined.	4. Rounded, shallow, never undermined.
5. *Surrounding Tissues.*—Very slight areola, unless there be old scars or other foci of syphilitic infiltration.	5. Extensively and irregularly pigmented, thickened and adherent.

Besides this, there is on the one hand a history of syphilis, on the other varicose veins.

TERTIARY LESIONS OF THE UPPER RESPIRATORY TRACT

DIFFUSE SCLEROTIC GLOSSITIS

The lesion is a diffuse sclerosis in the muscle of the tongue. It is quite rare and is always accompanied by superficial glossitis, either simple depapillation or leukoplakia.

GUMMA OF THE TONGUE

Gumma of the tongue is relatively rare. One-third of the cases are associated with sclerosis of the tongue.

EPITHELIOMA	GUMMA
1. *Occurrence.*—Almost exclusively in men over forty-five years of age.	1. Any age; either sex. History of previous syphilis.
2. *Situation.*—Usually on edge; may be on under surface.	2. Usually on dorsum. Never on under surface.
3. *Number.*—Single.	3. May be multiple.
4. *Leukoplakia.*—May precede.	4. May accompany.
5. *Characteristics.*—A shallow, fungating ulcer, with thick, everted edges, upon a base of wooden hardness. It bleeds very readily; its discharge is foul.	5. A deep sloughing ulcer, with sharp, undermined edges, upon a moderately indurated base. It does not bleed readily; its discharge is not very foul.
6. *Pain.*—Severe and lancinating.	6. Slight or absent.
7. *Lymph Nodes.*—Soon and progressively enlarged.	7. Enlargement slight or absent.
8. *Biopsy.*—Epithelial pearls.	8. Gumma.
9. *Treatment.*—No medicines have the least effect.	9. Salvarsan.

ULCERATION OF THE PALATE AND VELUM

The typical and terrible lesion of syphilis is *the phagedenic gummatous ulcer.*

This begins as a diffuse infiltration, producing redness, tumefaction, and relative immobility of the velum. But it causes scarcely any pain, and the patient usually pays no attention to it until, suddenly, ulceration and phagedena set in.

The onset of phagedena is exceedingly rapid. The patient goes to bed at night thinking himself well, and awakes with a hole in his palate, or with great patches of necrosis replacing what the day before was a comparatively innocent, painless infiltration. Even now the pain is not great, and the discomfort is inconsiderable. But the foul odor from the sloughing tissue, or the sense of a hole in the velum, soon brings the patient to his physician.

Examination then reveals either an area of dark greenish slough in the palate, or else a perforation surrounded by a slough. If the perforation is of any size the voice assumes a nasal quality and the breathing may be accompanied by a rattling gurgle, due to the flapping to and fro of partially detached bits of the palate. When the patient tries to swallow he has great difficulty in preventing fluids from regurgitating through the perforation into his nose.

GUMMA OF THE NASAL SEPTUM

Gumma of the nasal bones is always insidious and rapidly destructive in its onset, like that of the palate and the velum.

The septum is the part usually involved.

The first symptom noticed by the patient is an increase in the discharges from his nose and the presence of blood in these discharges. He will also confess that the sense of smell is either blunted or completely lost.

Examination (anterior rhinoscopy) reveals a perforation in the septum, which is usually situated at least an inch from the anterior nares, though it may appear at the junction of bone and cartilage. This perforation is either surrounded by a sloughing sore or else plugged with scabs and dead bone.

Severe or neglected cases go on to total destruction of the nasal septum, and may be identified the moment they enter one's office by the peculiar snuffling, purring sound, due to the flapping of necrotic tissue excited by the breathing.

With the healing of such a lesion the bridge of the nose sinks in, and may even fall flat to the level of the patient's face if all the bones have been destroyed.

TERTIARY SYPHILIS OF THE LARYNX

The tertiary lesions of laryngeal syphilis are:

Ulceration.
Gumma.
Fibroid degeneration.
Perichondritis.
Paralysis.

The common symptom is painless chronic aphonia, the *vox rauca syphilitica.*

SYPHILIS OF THE INTERNAL EAR

The symptom of syphilis of the internal ear is nerve deafness; coming on suddenly and rapidly becoming complete. It may occur at any time after the appearance of secondary lesion and is one of the commonest forms of relapse of syphilis in the nervous system after the administration of salvarsan. The lesion is either in the labyrinth or in the nerve itself. Even though resulting from the administration of salvarsan, like other evidences of relapse thereafter, it may be best cured by the administration of the same drug (Ellis and Swift).[1]

[1] *Jour. A. M. A.*, 1915, lxiv, 1471.

CHAPTER LXXXIX

SYPHILIS OF THE NERVOUS SYSTEM, THE EYE, THE BONES, THE VISCERA, AND OTHER REGIONS

SYPHILIS OF THE NERVOUS SYSTEM

Grouping the lesions of syphilis according to the tissues involved, one may affirm that syphilis of the skin is the most frequent, syphilis of the mucous membranes the most infectious, syphilis of the nervous system the most malignant manifestation of the disease. Syphilis of the nervous system is indeed malignant in that it occurs in a large proportion of syphilitics and that its lesions are always grave and often incurable.

Thus, among my 2,500 cases, 504 (20 per cent) were afflicted with syphilis of the nervous system, and of all late lesions, 42 per cent were in the nervous system.

Etiology.—There is good reason to believe that every lesion of syphilis in the human body results from an infection occurring at the time which may be loosely described as that of the outbreak of secondary symptoms. Examination of the spinal fluid shows some evidence of syphilitic invasion of the central nervous system in from 60 to 70 per cent of cases at this period (Wile and Stokes).[1] Indeed in perhaps 10 to 15 per cent of cases the invasion of the nervous system can be demonstrated even before the skin lesions of secondary syphilis appear.

This early infection of the nervous system may permanently subside, or may, within the first few years of the disease, give rise to characteristic syphilitic infiltration of the meninges, or of the arteries, that result in the so-called cerebrospinal syphilis. Although tabes and paresis have been shown to be definitely the effect of syphilis, inasmuch as the infected tissue contains spirochetes, yet these two conditions are peculiar both in their pathologic characteristics and in the fact that they do not develop until at least three or four years, and usually from 8 to 15 years, after the infection of the individual. This is doubtless due to sensitization of the nervous tissue by an early infection on account of which it reacts later in the form of tabes and paresis (cf. Collins [2] and Fordyce [3]).

[1] *Jour. A. M. A.*, 1915, lxiv, 979.

[2] *Ibid.*, lxv, 139.

[3] *Am. Jour. Med. Sciences*, 1915, cxlix, 781.

Nageotte observed in 1894 that a slight meningitis about the posterior nerve roots affecting these and ascending with them to the cord was apparently the earliest lesion of tabes. This view, though disputed at first, has gradually been accepted and the same interpretation has been placed upon paresis. Both of these so-called parasyphilids are, therefore, now believed to be due to an early meningitis, a sensitization of the tissue of the nervous system and the subsequent syphilitic outbreaks therein in later years causing a combined meningitis and encephalitis or atrophy of the lateral columns of the cord.

Occurrence.—Collins has classified 100 cases of syphilis of the nervous system of which the earliest appeared one month after the onset of chancre, the latest 30 years thereafter. In 6 the symptoms began within a year. The greater number developed in from 3 to 7 years. A clear history of secondary lesions was obtained in only 29 cases, and only 37 cases received the full routine early treatment (mostly of the presalvarsan period). These figures present the clinical facts quite graphically. Probably a larger proportion of cases than appear in these statistics have definite headaches during the first six months of the disease. But these usually subside spontaneously and the case that is to suffer subsequently from grave lesions in the nervous system is one which has usually had but few early symptoms and but little or no treatment therefor.

Pathology.—The predominating lesions are meningeal infiltration which is seen most commonly and characteristically about the base of the brain, and arterial syphilitic disease that results in gumma, thrombosis, or rupture of the vessel, and the sclerotic processes of tabes and paresis.

The changes in the cerebrospinal fluid have already been alluded to (p. 809).

Symptoms.—Collins[1] classifies the *symptoms of brain syphilis* as follows:

1. Headache.—Headache is the constant symptom of all syphilitic lesions of the brain. If severe it is usually characteristically nocturnal in type, being greatly relieved by day and may be of the greatest intensity. But in connection with the graver and later lesions the headache may be both mild and inconstant.

2. Alteration of Personality.—This is often slight showing itself only in inaccuracy or inattentiveness of mind, often interpreted as neurasthenia, and in the graver conditions passing to complete insanity.

3. Paralysis of the Cranial Nerves.—Affections of the motor oculi are the most frequent, causing diplopia and ptosis. Any or all of the cranial nerves may, however, be involved in the basal meningitis,

[1] *N. Y. Med. Jour.*, Feb. 26, 1916.

deafness and blindness being not unusual results, while arterial lesions of the hemispheres may lead to hemiplegia.

Pupillary irregularity and fixity and the so-called Argyll-Robertson pupil are as rare with the early as they are common with the later lesions of syphilis of the nervous system.

4. Insomnia.

5. Disorder of Motor Function.—Shivering attacks, stiffness, convulsions, paralyses, pain, aphasia, etc.

Symptoms of Spinal Cord Lesions.—The most striking symptoms are paralysis, partial and complete, of bladder and bowel, ataxia or muscular incoördination, paresthesia, derangement (e. g., Argyll-Robertson pupil, Babinski's sign) and abolition of reflexes, and pain. Even the briefest clinical study of these various manifestations require far more space than we have to devote to them. They are not mutually exclusive, nor is it possible always to predicate with absolute accuracy a given lesion to a given set of symptoms; for the lesions are usually irregular and acute, the symptoms complex and confusing.

Diagnosis.—Among the more striking features in the clinical diagnosis of syphilis of the nervous system, we may mention the following:

1. Apoplexy or hemiplegia occurring before the age of forty-five is usually syphilitic.

2. Ocular paralysis and nerve deafness are usually syphilitic.

3. Fixity and irregularity of the pupil with tremor of the tongue is a suggestion of paresis.

4. The lesions of tabes may exist for many years without showing any striking reflex changes excepting abolition of the ankle jerk.

5. Spastic spinal syphilis gives a clinical picture grossly simulating tabes, but with exaggeration instead of diminution of reflexes.

6. The differential diagnosis of these various lesions is made upon the clinical symptoms supported by the investigation of the spinal fluid (p. 809).

Prognosis.—If taken in time, syphilis of the nervous system, however grave, however fulminating, may often be controlled and actually cured, so that no trace of it remains. The wildest mania, the deepest coma, the most complete paralysis, may yield like magic to prompt and efficient treatment. Medicine can boast no miracle greater than the effect of specific treatment upon syphilis of the nervous system.

But such wonders cannot always be accomplished even by prompt and efficient treatment. In any case, if treatment is delayed until the nerves have degenerated and muscles atrophied, it is vain to ask of any treatment the real miracle that would be required to restore the patient to perfect health.

SYPHILIS OF THE EYE

Iritis.—It occurs usually between the fourth and the twelfth month of the disease. Half the cases of iritis seen by the ophthalmologist are said to be syphilitic.

Diagnosis.—*Is the iritis but one of a number of ocular lesions?* This question always merits an accurate answer; for, while no lesion is more benign than the mild iritis of early syphilis, no lesion is more fatally misleading than that same iritis when it conceals the onset of chorioretinitis.

Hence every syphilitic iritis demands a thorough ophthalmoscopic examination.

Chorioretinitis and Retinitis.—Syphilis is the most frequent cause of chorioretinitis, one of the rare causes of retinitis.

Optic Neuritis.—The optic nerve is said to contribute 25 per cent of ocular syphilis. It is one of the common nerve lesions.

Interstitial Keratitis.—This is common in hereditary syphilis, extremely rare in acquired syphilis. Many authorities maintain that all interstitial keratitis is syphilitic.

SYPHILIS OF BONE

Bone syphilis resembles brain syphilis in this: it may manifest itself first by pain, worse at night (osteocopic pains, headache), at the time of the first general outbreak of symptoms, and the lesion may follow one of three courses, viz.:

1. The pain having been relieved by time or treatment, no further bone (or brain) lesions may appear, or

2. The pain may be followed (with or without an interval of remission) by grave bone (or brain) lesions, or

3. The grave lesions may attack a bone (or brain) in which no pain was felt at the onset of secondary symptoms.

Pathology.—There may be osteoperiostitis, gummatous periostitis, or osteomyelitis.

Syphilitic osteoperiostitis (the usual lesion) is an exudative thickening of the periosteum, which results in productive osteitis and the formation of bony exostosis unless promptly checked by treatment. The tibia is the bone most often involved.

Symptoms.—Osteoperiostitis.—The lesion, as a rule, develops very slowly. When once established, this shows itself as a thickening of the bone. It is usually situated near the extremity of a long bone (tibia, clavicle, ulna), and is diffuse, irregular, insensitive, and without sub-

jective symptoms. Such a deformity simulates nothing else than an exuberant callus, following fracture, from which it may be readily distinguished by the history. The patient usually attributes the pain at the onset to some imaginary injury.

Gumma.—This lesion usually follows an acute course in marked

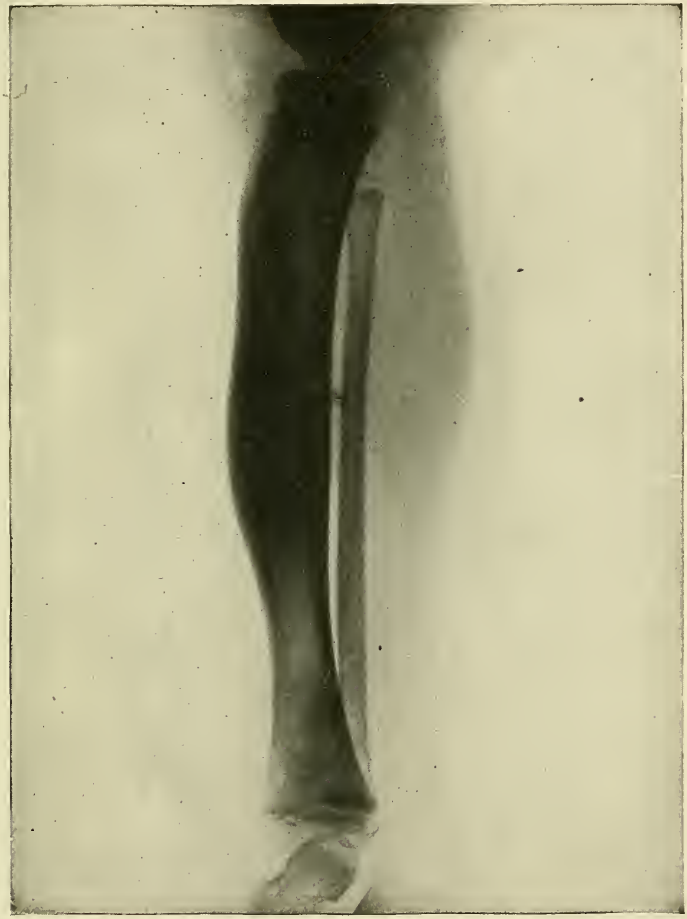

Fig. 201.—Saber Tibia of Hereditary Syphilis. Diffuse osteosclerosis of shaft of tibia projecting outward and also encroaching upon the medullary canal. (Case of Dr Jaeger. Skiagraph by Dr. Cole.)

contrast to the chronicity of productive osteoperiostitis. The onset is usually sharp with pain and tenderness.

Swelling.—The swelling which may be obscured by the deep situation of the bone (spine, femur), is at first a flattened, hard, circumscribed, tender swelling attached to the bone. As it grows, it becomes softer; the tissues over it first adhere, then become edematous, and

finally involved in the gumma. In its subcutaneous situations (tibia, cranial bones) periosteal gumma passes through precisely the same clinical phases as does subcutaneous gumma, except that it is from the beginning adherent to and in some measure incorporated in the bone.

Diagnosis.—The x-ray discloses a typical wavy irregularity and

Fig. 202.—Gumma of Inner Condyle of Femur and Outer Condyle of Tibia (Hereditary Syphilis); Arthritis. (Compare normal joint.) (Case of Dr. Jaeger. Skiagraph by Dr. Cole.)

thickening of the periosteum, even at a distance from the clinical lesion, and often also in bones that are not recognizably diseased (Fig. 201).

Gumma shows as an erosion (Fig. 202) and is always accompanied by periostitis.

A *fracture,* with bone ends in apposition, *that does not unite* is usually syphilitic, even though history, physical examination and x-ray reveal nothing.

SYPHILIS OF THE ARTICULATIONS

Syphilis simulates every joint disease from rheumatism to tuberculosis. Its lesions may be classified under the following types:

Arthralgia.

Hydrarthrosis.

Pseudorheumatism (extremely rare).

Tertiary arthritis and osteo-arthritis (gummatous).

Deforming arthritis.

Syphilitic Arthralgia.—The special characteristics of syphilitic arthralgia are:

1. There is no discoverable lesion sufficient to account for the pain.

2. Nocturnal exacerbation and relief by exercise.

3. Frequent in larger joints (shoulder, knee, elbow), rare in smaller ones; if polyarticular, one joint is usually much more painful than any other.

Diagnosis.—The x-ray shows syphilitic periostitis.

SYPHILIS OF THE MUSCLES

Apart from the muscle pains that may occur in early syphilis, syphilis of muscles is extremely rare. I have record of only two cases, one of torticollis (sternomastoid spasm), one of bicipital contracture.

The lesions described are: Contracture, interstitial myositis, gummatous myositis, myositis ossificans.

Tendons and aponeuroses are scarcely ever involved except by extension of a syphiloma from the surrounding parts. The occipitofrontal aponeurosis is said sometimes to be inflamed in early syphilis. I have record of one case of gumma of the tendo Achillis in a patient with many other tertiary lesions.

Acute bursitis or chronic bursitis with effusion may complicate arthritis. It is extremely rare.

Gummatous bursitis is far more common. It occurs almost always in the prepatellar bursa.

SYPHILIS OF TRACHEA, BRONCHI, AND LUNGS

Syphilis of the trachea and bronchi is associated clinically, on the one hand, with laryngeal syphilis, on the other with lung syphilis; but bronchial or peribronchial syphilitic lesions are entirely distinct from

those beginning in the lung tissue. These lesions are extremely rare. They are diffuse infiltrations in and about the trachea with surface ulceration irregular in extent and depth.

Syphilitic Pneumonia.—The interstitial pneumonia caused by syphilis is seen as an uncomplicated process almost exclusively in cases of hereditary syphilis. This is the *white pneumonia of the new-born.*

Cicatricial Lesions.—Syphilitic sclerosis of the lung is the common pulmonary lesion of acquired syphilis. It is usually irregular in distribution, and is believed to be more common in the lower than in the upper lobe, in the right than in the left lung (cf. Stanley[1]).

Bronchiectasis.—Associated with the interstitial syphilitic changes in the adult lung one almost always finds bronchial dilatation of various shapes and sizes. In many instances the bronchiectasis is so marked as to be the chief lesion and produces cavities of considerable size, the presence of which can be determined during life.

Hereditary Pulmonary Syphilis.—Usually there are no symptoms. The patient is either still-born or dies within a few hours, and a white pneumonia is discovered among other visceral lesions after death.

In the Adult.—The following types are recognized:

1. The silent type.
2. The bronchopneumonic type.
3. The tracheal type.
4. The pseudotubercular type.

The diagnosis is suggested by associated lesions in the other viscera, by the Wassermann reaction, by the absence of tubercle bacilli from the sputum, by the x-ray, and by the effect of salvarsan.

SYPHILIS OF THE LIVER

Jaundice is a frequent symptom in grave hereditary syphilis: post mortem the liver is found packed with spirochetes. A similar jaundice, but mild and transient, occurs in the early months of acquired syphilis—usually before the skin lesions appear.

But the term "liver syphilis" is broadly applied, not to this transient lesion, but to the sclerogummatous lesion, which is one of the commonest and most obvious visceral manifestations of syphilis.[2]

Occurrence.—Tertiary syphilis of the liver occurs in the later years of the disease. It is often not diagnosed during life; hence one cannot keep an accurate clinical record of its frequency. Alcohol, hardship, and neglect are obvious etiological factors.

Pathology.—The liver is usually large and deformed. It may or

[1] *Brit. Med. Jour.*, Oct. 7, 1911.

[2] Cf. Schrayer, *Jour. A. M. A.*, 1912, lviii, 681.

may not be adherent to the surrounding organs; but the *capsule* almost always shows more or less irregular whitish thickening. This thickening may be due to a diffuse productive perihepatitis or to the thick scars left by healed gummata.

The irregular shape of the liver is due to *bands of dense sclerotic tissue* traversing it irregularly, crisscrossing at various points.

The gummata are found either as hard, yellowish nodules or as cheesy masses at the intersection of several bands of sclerosis or beneath (and involving) the capsule. These gummata are rarely smaller than a pea, and may attain an enormous size, projecting noticeably from the surface of the enlarged viscus. They are usually quite numerous.

Symptoms.—The symptoms of hepatic syphilis—when it excites symptoms—are usually comparable to those of (nonsyphilitic) cirrhosis or of neoplasm. There may, however, be no local signs of disease, in which case there may be fever or a marked and progressive cachexia.

We may, therefore, classify the types of hepatic syphilis according to the nonsyphilitic lesions which they simulate, arranged in what is probably their order of frequency:

1. Neoplastic type.
2. Cirrhotic type.
3. Cachectic type.
4. Febrile type.
5. Silent type.

SYPHILIS OF THE STOMACH AND INTESTINES

Sclerogummatous syphilitic infiltration of the lower six inches of the *rectum* is a recognized cause of stricture in that part of the gut. It is usually a pathologic post mortem finding. Rare instances of syphilis have also been recorded in other parts of the *intestines* as they have in the *pancreas* and *spleen,* etc.

Syphilis perhaps causes a minority of the *ulcers of the stomach,* but the pathologic diagnosis is almost as confusing as the clinical diagnosis is vague.[1]

SYPHILIS OF THE TESTICLE

(See page 592.)

[1] Cf. Downes and Le Wald, *Jour. A. M. A.,* 1915, lxiv, 1824; Brusch and Schneider, *Berl. klin. Wochenschr.,* 1915, lii, 23; Curtis, *Jour. A. M. A.,* 1909, lii, 1159; Rudnitski, *Arch. f. Verdauungskrank.,* 1909, xv, 1.

SYPHILIS OF THE HEART AND ARTERIES

All syphilis is vascular syphilis; but certain of the late lesions of syphilis, especially affecting the vascular system, are worthy of note.

Syphilis of the Heart.—*Gumma* of the heart is rare, usually occurs in the silent portions of the organ, is not diagnosed during life, and is said to be the cause of one-third to one-half of sudden deaths (Breitmann[1]).

The usual gross heart lesion of late syphilis is *aortic regurgitation,* a lesion often associated with *aortitis, aortic aneurysm, and disease of the coronary arteries.*[2]

Aortitis and Aneurysm.—Syphilis is the cause of practically all aortic aneurysm, just as it is the cause of practically all aortic regurgitation. The symptoms of inflammation of the aorta may be nil, or there may be attacks of cardiac palpitation or angina, or persistent pain in the left shoulder, or a dry cough. The Wassermann reaction is almost always positive, the x-ray shows a distinct thickening of the aorta.

The suggestion that patients with aneurysm bear salvarsan badly has not been borne out by experience, but the administration of the drug should be preceded by a definite course of severe mercurialization and salvarsan should at first be administered in small doses.

[1] *Berl. klin. Wochenschr.,* 1911, xlviii, 39.

[2] Recently pathologic studies have been published by Soprana. *Riforma Med.,* May 29, 1915; Larkin and Levy, *N. Y. State Jour. of Med.,* 1915, xv, 466.

CHAPTER XC

HEREDITARY SYPHILIS

The modern syphilographer recognizes no paternal or maternal heredity of syphilis. For him the mother of every syphilitic child is syphilitic, the father may or may not be so.[1] The infection is always postconceptional for it is not conceivable that a syphilitic ovum should develop at all. If the fetus is infected early in pregnancy it promptly dies and an abortion occurs on the third or fourth month. If later, it is born syphilitic, for attenuation of the virulence of the spirochetes seems to occur within the mother. Untreated mothers almost always show a succession of pregnancies the first one terminating in abortion within a few months, the succeeding ones in the birth of obviously syphilitic children, while the last children to be born, though they usually develop syphilis in the later years of life, may reach puberty without any sign of the disease. The problem involved has been studied by Baisch.[2] Fildes [3] studied 1,000 mothers and infants both clinically and serologically. Four per cent of the women gave a positive reaction, but only 1 in 9 of these transmitted the disease to her child. Post [4] has tabulated the early mortality from 168 pregnancies in 30 families. There were 53 still births and 44 deaths within the first year (a total mortality of 57 per cent). Of the remaining 71, 39 are presumably healthy, 32 are known to be syphilitic. Hochsinger [5] has followed the history of 263 children born alive among his private patients for from 4 to 24 years. Only 14 per cent died during the first year, while 72 (25 per cent) grew up to be healthy adults, though 21 of these were scarred (19 saddle noses, 17 hyperostoses, and 7 scarred lips). None of the children with pronounced symptoms soon after birth grew up healthy. He believes physical, mental and moral defects are commonly due to syphilitic heredity. The Wassermann reaction is remarkably persistent even in cases that show no subjective signs. If the child passes puberty without any manifestations of the disease it is not likely to be troubled during the rest of its life.

[1] *Arch. of Pediatrics,* June, 1911.
[2] *Muenschen. med. Wochenschr.,* 1909, lvi, 1929.
[3] *Jour. of Obstet. & Gyn. of the British Empire,* 1915, xxvii, 124.
[4] *Boston Med. & Surg. Jour.,* 1913, clxx, 113.
[5] *Wiener klin. Wochenschr.,* June 23, 1910.

All of these statistics date from the presalvarsan period.

The important features of hereditary syphilis may be subdivided as follows (Hochsinger):

1. Fetal syphilis.
2. Infantile syphilis (first three to six months).
3. Relapses in infancy (until the fifth year).
4. Late hereditary syphilis.

The importance of these stages decreases throughout the series. Thus fetal syphilis is fatal to about one-half the infected children. Infantile syphilis kills almost half of the survivors in the first three months of extra-uterine life. The later relapses in infancy are less frequent, less severe, and rarely fatal; while the so-called "late" or "delayed" hereditary syphilis, which occurs after the fifth or sixth year, differs in no respect from tertiary syphilis in the adult. But the adult who has suffered hereditary syphilis in infancy bears upon his body certain evidences of the storm that has passed. These form a fifth division:

5. Stigmata of hereditary syphilis.

FETAL SYPHILIS

Pathology.—The pathology of fetal syphilis differs from the same process in the adult chiefly in its hyperacuteness. In the adult the disease localizes itself here and there in small areas and shows a special affinity to the skin and mucous membranes, and later to the nervous system, the underlying process being always specific arterial disease. But in the fetus the chief localizations are in the viscera, and secondly in the bones; the skin is immune until just before or just after birth. Moreover, the hyperacuteness of the process is shown in its diffusion throughout an organ, contrasting strikingly with the circumscribed visceral involvement in the adult.

The viscera most frequently and most markedly affected are, in order of their importance, the lungs, the liver, the kidney, and the spleen.

The type of congenital syphilis is a diffuse cell proliferation arising from the perivascular connective tissue of the smallest vessels, so that the solitary syphiloma is very rare in the fetus and the infant.

The infiltration is exclusively a diffuse one arising from the smallest vessels in the organ, with a special tendency to later contraction and obliteration of these vessels. The perivascular proliferation begins in a sleevelike way in the adventitia and extends outward into the connective tissue, less often into the inner wall of the artery, thus obliterating it. In all the diseased organs one finds here and there dense cell accumulations visible to the naked eye and spoken of as "miliary syphilomata" or "gummata."

In the affected organs we find checked development of the parenchyma, abnormal development of the Malpighian bodies, persistent epithelial rests and canals, cystic development of the cortex of the kidney, etc. *Thus the hyperplasia of the connective tissue goes hand in hand with a hypoplasia of the parenchyma.* These changes can often not be made out macroscopically, and we note only an increase in volume and density of the liver and spleen (Hochsinger).

The placenta usually shows changes similar to those in the fetal viscera. Both the maternal and fetal portions of the placenta show the diffuse perivascular infiltration, so that the placenta is more voluminous and heavier than normal (it may reach one-fourth or one-third the weight of the child); the cord is also hard and considerably enlarged.

Symptoms.—The fetus affected with syphilitic visceral lesions may come to one of three ends, as follows:

1. It may be aborted or still-born.
2. It may be born manifestly syphilitic.
3. It may be born apparently healthy.

1. *The death of the fetus in utero* is often caused by hydramnia, depending upon syphilitic phlebitis of the cord; or by inanition from overwhelming visceral disease. Abortion usually occurs between the fourth and the seventh month, and the fetus thus aborted is usually dead and macerated. Monstrosities are said to be relatively frequent because of the interference with placental circulation.

2. *The typical syphilitic infant* presents a picture of pseudosenility —thin, feeble, marantic, with a dull, *café au lait* color, a wrinkled, loose skin, upon which, even at birth, there may be an eruption; with the snuffles, with a hoarse cry, with sunken and inflamed eyes, and perhaps with pseudoparalysis or some lesion of the nervous system, the unfortunate infant forms a horrible picture of the ravages of hereditary syphilis.

3. *But the child with syphilitic lesions of the viscera may be born seemingly in good health.* Among the syphilitic infants born alive relatively few present so marked a picture of the disease. Not only may the infant be born with no actual syphilitic lesions apparent, but he may be in good condition. The skin is likely to be lacking in pinkness and fullness and the infant rather under weight. Thus Tarnier, among 52 syphilitic children, found 14 of normal weight (above 3,250 gm.) and 38 below it (Hochsinger), while Vas[1] found that even breast feeding did not keep them up to normal.

The direct evidence of the syphilitic visceral lesions is the enlargement of spleen and liver or of the pseudoparalysis from osteochondritis.

[1] *Jahrb. f. Kinderheilk.*, Apr., 1912.

INFANTILE SYPHILIS

Although the lesions presented by the infant with hereditary syphilis are due to precisely the same protozoal cause as those in the adult, they are markedly dissimilar. Thus we have seen that, in the fetus, the viscera are the chief points of attack. In the infant the disease first strikes the mucous membrane of the nose, producing snuffles, and then shows itself by lesions upon the skin; but these skin lesions are not the same in character as those of early syphilis in the adult, nor are they by any means constant.

Intermingled with these symptoms, or succeeding them, there may be evidences of bone or visceral disease, or the little patient may show his malady simply by his thinness, his slow gain in weight, and his restlessness.

Taking up the early symptoms in order of clinical importance, we shall discuss:

Inflammation of the nose.
Inflammation of the skin.
Inflammation of the bones, joints, and muscles.
Inflammation of the viscera.
Mixed "infection" (pyogenic or tuberculous).
Syphilitic dystrophies.

INFLAMMATION OF THE NOSE

"Snuffles" is the earliest and most constant symptom of hereditary syphilis, and one of the least characteristic.[1] The symptom is not quite that of snuffles in an older child, for at first there is little or no running from the nose, but only an obstruction to nasal respiration which makes the child breathe in a characteristic snuffly way and gravely interferes with nursing.

Hochsinger has tabulated 65 cases, of which 38 began at birth, 15 in the first month, and 12 later than the first month.

The inflammation begins as hypertrophy of the nasal mucous membrane, at first a dry congestion beginning in the lower part of the nose, which soon goes on to ulceration and causes a profuse mucous discharge, often tinged with blood; epistaxis is most exceptional. The discharge is acrid, and excoriates the upper lip. Perforation of the septum is rare in infancy but the development of the nasal bones is impaired or arrested and the bridge of the nose left sunken in a characteristic manner (later relapses of hereditary syphilis of the nose commonly

[1] For it may be due to many causes.

cause perforation). Hence the nasal deformity so suggestive of syphilis (Fig. 203).

The first clinical evidence of this nasal disease is *restlessness,* due to the fact that the little patient cannot sleep because of the difficulty of breathing through its stopped up nose. The *snuffly breathing* soon follows, and the infant, being unable to breathe through its nose, may be *almost totally unable to nurse;* its attempts at suckling and swallowing being frustrated by the rapidly recurring need of breathing, so that the process becomes a disheartening series of gasps, chokings, and regurgitations, which result in the ingestion of little or no nourishment. Thus this relatively insignificant lesion may be the chief cause of a grave impairment of nutrition.

Fig. 203.—Syphilitic Nose.

INFLAMMATION OF THE SKIN

The striking characteristics of the first skin lesions of hereditary syphilis are:

1. Polymorphism.
2. Regional distribution.
3. Confluence.

Most of the lesions are papular or maculopapular, while an occasional macule may be seen. The papular eruption of hereditary syphilis is quite comparable to that of acquired syphilis, except that it is commonly intermingled with lesions of a macular character, and is itself often confluent.

Polymorphism.—On account of the tenderness of the skin this papulomacular eruption very readily takes on secondary changes. In dry regions the lesions tend to become squamous, or, if the eruption is severe, bullous or pustular; while in moist regions the lesions are confluent, erosive, ulcerated, or condylomatous.

Regional Distribution.—The eruption usually appears about the genitals, the buttocks, the flexor surfaces of the thighs, upon the palms and soles, and upon the lips and chin. The scalp, arms, and legs are somewhat less frequently affected, while the upper part of the trunk above the line of the diaper is relatively immune, doubtless because it is the dryest and thickest skin upon the infant's body.

Confluence.—The marked tendency to confluence shown by the early skin lesions of hereditary syphilis is due to the tenderness of the skin and the difficulty in keeping it clean; hence the confluent lesions are usually seen under the diaper, in various moist creases of the body, and about the mouth.

It is convenient clinically to distinguish four types of lesions:

1. Pemphigus.
2. Circumscribed or diffuse maculopapular syphilid (see above).
3. Lesions of special regions.
4. Tubercular or gummatous syphilid.

PEMPHIGUS

The earliest, one of the rarest, and the most ominous skin lesion of hereditary syphilis is pemphigus, or the bullous syphilid. It appears before birth or in the first week of extra-uterine life, less often in the two or three weeks following. Its typical situation is upon the palms and soles, whence it may spread over the rest of the body.

The eruption consists of large, copper-colored papules, upon which are set flaccid blebs containing serum and pus or blood. As these rupture they leave an eroded surface; or, if the ulceration is deep, greenish scabs take the place of the ruptured bullae. When this eruption occurs before the second week of extra-uterine life it is an accepted sign that the child will die.

Diagnosis.—It may be readily distinguished from the pemphigus neonatorum, which never occurs before the second week, and usually much later, is often epidemic, occurs upon otherwise healthy children, and only most exceptionally appears upon the palms and soles.

LESIONS OF SPECIAL REGIONS

Erosions of the Lips.—Eroded mucous papules are very common upon the vermilion border of the lips, and are promptly fissured and transformed into deep-red, oozing cracks, surrounded or covered by a little crust. They are usually multiple, and are commonest at the angle of the mouth. They are extremely painful, and interfere gravely with suckling. As they heal they leave radiating linear scars upon the lips, which in later years form one of the most striking and reliable stigmata of hereditary syphilis.

Anogenital Lesions.—These are usually associated with dry or scaly papules elsewhere in the body, and are themselves confluent, erosive, or ulcerated, rarely condylomatous, and still more rarely pustular. But in the relapses of early childhood condylomata are very common.

Onychia and Paronychia.—The typical nail of the syphilitic infant is raised high in the center and depressed laterally, as though it had been pinched by a forceps. It resembles a claw rather than a nail. The condition usually affects all the nails. Such nails are often undermined by paronychia, so that they are readily detached.

Lesions of the Scalp.—The moth-eaten poll is quite uncommon in infancy, and more extensive baldness (which has the same characteristics as in the adult) very rare.

The papular eruption upon the scalp, instead of forming small, disseminated, crusted lesions, as in the adult, may produce an extensive incrustation closely simulating eczema; but removal of the syphilitic scab leaves an intact, though infiltrated, area beneath it, while removal of an eczematous crust leaves the malpighian rete exposed.

TUBERCULAR AND GUMMATOUS SYPHILID

It is not always possible to distinguish between a furuncle and a syphilitic tubercle or gumma; indeed, these lesions are classed as "furuncular syphilids" by Taylor, while their syphilitic nature is entirely denied by Jacquet. They are, however, accepted by most authorities, and Carpenter states that among 364 syphilitic eruptions seen by him during the first year of life there were 70 cutaneous gummata, 34 of which were associated with other lesions of the skin.

The lesion is a syphilitic tubercle or a subcutaneous gumma; it often becomes pustular, and so remains for a considerable time before ulcerating.

LESIONS OF THE MUCOUS MEMBRANE

Excepting the nose, the lips, and the anus, lesions of the mucous membrane are extremely rare. The ulcers that occur in the mouth are alleged by many authors to be aphthous, not truly syphilitic.

Aphonia is frequent, however, due to infiltrative and ulcerative laryngeal lesions similar to those seen in the adult. The familiar "hoarse cry" of the syphilitic infant is quite as suggestive and far more common than the hoarse voice of the syphilitic adult.

The intestine may be inflamed, and show post mortem a diffuse thickening of the mucous membrane with ulceration.

INFLAMMATION OF THE BONES

While any of the lesions of bone that occur in the adult may also occur in hereditary syphilis,[1] the two striking and distinctive characteristics of bone syphilis in the infant are osteochondritis and periostitis.

Osteochondritis.—Mild syphilitic osteochondritis, causing slight distortion and enlargement of the bone at the epiphyseal line, is very

[1] Cf. Fitzwilliams, *Brit. Jour. Children's Dis.*, March, 1912.

common. Its lesions can be accurately studied only by the x-ray. It appears almost always in the first six months.

The knee and the elbow are most commonly and most markedly affected and the lesion consists in a syphilitic infiltration of the diaphysis at its junction with the epiphysis, which results in a thickening of the bone at this point and a marked irregularity at this line of junction. Very rarely this lesion progresses so far that the granulomatous tissue, disintegrating the epiphyseal cartilage, produces an epiphyseolysis. This rare lesion, appropriately called "syphilitic pseudoparalysis of the new-born," usually affects the elbow and is congenital; it may be polyarticular.

Periostitis.—The periosteal lesions of early syphilis are usually most marked upon the skull, though similar lesions may affect any bone. They are seldom encountered before the fourth year.

The lesions of syphilis in the skull are, in order of frequency: infiltration and softening between the tables and in the sutures; diffuse periostitis of the frontal or parietal bosses, causing an enlargement which, if frontal, produces the so-called "Olympian" brow; if lateral, a considerable widening of the transverse diameter of the skull (natiform skull). Less frequent is the rarefying ostitis with tendency to gummatous degeneration. Finally, the skull may be affected secondarily by hydrocephalus.

American authorities consider it unsafe to accept cranial deformities as evidence of hereditary syphilis unless supported by other typical signs. Parrott's nodes and craniotabes, though sometimes spoken of as syphilitic, are actually of rachitic origin.

Dactylitis.—Dactylitis is less uncommon in hereditary than in acquired syphilis. It occurs after the first year. It never affects the feet (Fitzwilliams).

INFLAMMATION OF THE VISCERA AND OTHER ORGANS

Lymph Nodes.—Lymphadenitis is not typical of hereditary syphilis. Marked epitrochlear adenitis is of some diagnostic importance. The presence of other enlarged nodes is, as a rule, directly attributable to adjacent lesions.

Testicle.—Syphilitic sclerosis of the testicle is extremely common in still-born children. It is rare in those that survive.

Inasmuch as the size of the testicle in infancy varies between wide limits, while syphilis of the organ often does not greatly alter its size, the clinical manifestation of the lesion is usually an *increase in hardness,* which may be masked by hydrocele. Testis and epididymis may be involved separately or together. The lesion usually leads to atrophy

of the testicle, and great stress is laid by certain authors upon the existence of this atrophy in adult years as an evidence of hereditary syphilis.

Diagnosis.—Inasmuch as tuberculosis of the testicle may occur shortly after birth (Dreschfield has recorded a congenital case), and produce lesions macroscopically similar to those of syphilis, the diagnosis should be confirmed by a Wassermann reaction.

Liver and Spleen.—Hereditary syphilis of the liver and spleen are so intimately associated that it seems proper to consider them as one. Syphilitic changes may be found in these organs in many instances post mortem, although no evidence of such disease was apparent during life.

The pathological changes have already been described.

Clinically, the manifestation of these lesions consists in an enlargement of the affected organs. This enlargement is noted in 30 per cent to 40 per cent of cases in the first three months of life; and in almost every instance enlargement of the spleen implies enlargement of the liver, and vice versa.[1] The enlargement, though usually slight, may be considerable, and, exceptionally, one may identify thickening of the edge and irregularity of the outline of the liver, as in acquired syphilis.

Syphilitic jaundice is extremely rare in early infancy. Ascites does not occur until a later age.

Lungs.—The lesions are so commonly fatal that they can scarcely be said to give any clinical manifestations.

Nervous System.—*Restlessness and sleeplessness* are striking symptoms of early hereditary syphilis, and have been referred to meningeal irritation, but are more often due to nasal obstruction. Though these early cases may show post mortem lesions throughout the nervous system, they show during life no evidence of peripheral neuritis or of syphilis of the cord; while symptoms of syphilitic meningitis other than restlessness, sleeplessness, and convulsions are extremely rare. The only exception is *hydrocephalus*. This, whether acute or chronic, internal or external, is often syphilitic, and develops with the first outbreak of symptoms (in the first or second month).

Eye.—Lesions of the eye are extremely rare at this early date.

Ear.—Extension of the nasal catarrh to the middle ear, resulting in acute otitis media, is not uncommon.

[1] Hochsinger found that splenic enlargement accompanied hepatic enlargement in 44 out of 46 cases. He also states that only 3 per cent of the infants showing enlargement of the spleen were not syphilitic. Carpenter states that when the spleen is enlarged the liver is also enlarged in four-fifths of the cases.

MIXED INFECTION

As a frequent and grave complication of early hereditary syphilis it shows itself chiefly in four types:

1. Mixed infection of the skin.
2. Mixed infection of the respiratory tract.
3. Mixed infection of septic type.
4. Tuberculosis and rachitis.

Skin.—Mixed infection of the skin shows itself in the frequency of pustular and ulcerating lesions, while pseudofurunculosis is due in most instances to pyogenic bacteria.

Respiratory Tract.—The discharges of syphilitic coryza swarm with all manner of bacteria. Hence the inflammation may spread to the ear, causing otitis media, or to the lung, causing bronchopneumonia. This latter complication accounts for many deaths.

Sepsis.—The petechiae and other hemorrhagic skin lesions that occur in certain malignant cases of early hereditary syphilis are, doubtless, evidences of acute septicemia.

Tuberculosis and Rachitis.—The relation between rachitis and syphilis has long since been determined. Parrott believed and taught that every rachitic child was syphilitic; but subsequent investigation has clearly shown that this is not the case, that syphilis is only one among many potential, debilitating causes of rickets.

The same is true of tuberculosis. Sergent [1] has recently collected much evidence in the matter, and, with a wealth of authoritative quotations, enforces his conclusions that *"la syphilisation du père a préparé le terrain pour la tuberculisation du fils"*—syphilis in the father prepares the soil for tuberculosis in the son.

This aphoristic statement expresses the actual condition not quite accurately. It is necessary to distinguish as follows:

1. Syphilis in the father, if severe or if allied with other debilitating influences, such as drink, deprivation, or debauch, prepares the father's own soil for tuberculosis.

2. Syphilis transmitted from parent to child—hereditary syphilis—exercises the same predisposing influence magnified by the difficulty of eradicating the disease from the vulnerable tissues of the new-born.

3. But the nonsyphilitic child of a syphilitic parent is not predisposed to tuberculosis, unless by such privation or neglect as would so predispose it in any event.

Although tuberculosis and rachitis are frequently attendant upon syphilis a little later in life, they scarcely figure in the first few months.

[1] "Syphilis et tuberculose," Paris, 1907.

SYPHILITIC DYSTROPHIES

The interference with nutrition due to hereditary syphilis shows itself in two ways: First, and most frequently, by killing the child within a few days of its birth; secondly, by impairing its nutrition, but not killing it.

The first evidence of impaired nutrition may be the puny, decrepit state of the child at birth; or it may be born apparently healthy, and promptly lose weight and strength in spite of a good digestion and an abundant supply of mother's milk. Such infants, though they may survive for a time, are carried off either by the cachexia of the disease itself or by such complications as convulsions, diarrhea, or bronchopneumonia during the first year of their lives.

From these various causes something like nine out of ten bottle-fed or hospital babies fail to survive, though in private practice hygiene, human milk, and intelligent medical care cut down the mortality considerably.

But beyond this obviously syphilitic toxemia there is a set of vague conditions, such as go to produce congenital deformities—e. g., club-foot, harelip, etc.—or to arrest development, causing the child to attain puberty very late, to have sex characteristics but slightly developed, and to remain childish both in mind and body. Idiocy and epilepsy are said to be exceptionally frequent in otherwise apparently healthy children of syphilitic parents (Lippmann[1]).

In how much these conditions are due to a real syphilis of the child and in how much to an inherited tendency from the parent (similar to that of alcoholism, for instance) it is difficult to say.

LATE HEREDITARY SYPHILIS

From the sixth to the eighth year, and again at about the time of puberty, hereditary syphilis may relapse; relapses excepting at these times are infrequent.

The arbitrary limit of twenty-six years set by Fournier for the duration of hereditary syphilis is, in general, the extreme limit; indeed, lesions after puberty are extremely rare.

The active syphilitic lesions of late hereditary syphilis are, with but very few exceptions, quite the same as those that occur in late acquired syphilis. They are, in other words, the tertiary lesions of the disease occasionally intermingled, as in acquired syphilis, with certain late secondaries, especially those of the palms, the soles, and the tongue. Cer-

[1] *Muench. med. Wochenschr.*, Nov. 23, 1909.

tain classes of lesions are, however, somewhat more common in late hereditary than in late acquired syphilis. Such are the various lesions of the eye, deafness from internal ear disease, perforation of the septum and palate, and diffuse periostitis of the long bones. The joints are relatively often affected, and the danger of mistaking a pseudotubercular syphilitic knee in the young for the tubercular "white swelling" must be borne in mind. Interstitial keratitis is not uncommon.

Tabes and Paresis.—Tabes and paresis due to hereditary syphilis occur at about the time of puberty. The first sign of tabes is usually enuresis (Spitzmueller), while delusions characterize paresis.

STIGMATA OF HEREDITARY SYPHILIS

The stigmata of hereditary syphilis are the scars of syphilitic lesions or the deformities or peculiarities in development left by syphilitic lesions occurring in infancy or in youth. They are more or less characteristic of the disease, though *only the radiating fissures of the lips and the typical saber tibia are absolutely pathognomonic.* Yet many of them are presumptive evidence of the greatest importance.

Only the important stigmata need be described.

The chief stigmata of hereditary syphilis may be classed as follows:

1. Hutchinson's triad, consisting of dental, ocular, and auditory stigmata.
2. Bone stigmata.
3. Skin stigmata.
4. Visceral stigmata.
5. Constitutional stigmata.

Of these, the first three are of prime importance, the two last are rarer and less characteristic.

The chief bone stigmata are found in the skull (frontal or lateral bosses, asymmetry and irregular development, hydrocephalus), in the nose (sunken bridge), and in the long bones (diffuse periostitis, saber tibia, and such scars of epiphyseitis as epiphyseal enlargements, and arrested or excessive growth of the bone). The skin stigmata do not differ from those of acquired syphilis, excepting the important lip fissures. The only notable visceral stigmata are atrophy of the testicle and parenchymatous keratitis. The constitutional stigmata consist of a gray, bloodless skin and a slowness of physical and intellectual development that may amount to "infantilism" or idiocy.

Diffuse Periostitis.—The periosteal changes of late hereditary syphilis are the same as those of acquired syphilis excepting in their distribution. The hereditary lesions are, however, often much more dif-

[1] *Med. Klin.*, Jan. 23, 1910.

fuse than the acquired ones, sometimes extending over the whole length of a long bone. This diffuse process is most common in the tibia, to which it imparts a peculiar and pathognomonic form. The shaft of the bone is thickened in all its diameters, but especially anteroposteriorly; so that, at first glance, the bone appears to be bowed forward; but palpation reveals that this bowing is simply a thickening around it of new bone without any deviation in its axis (Fig. 201).

Fig. 204. — Pezzer Self-retaining Catheter.

HUTCHINSON'S TRIAD

Most important among the stigmata of hereditary syphilis are those lesions grouped as a triad by Jonathan Hutchinson, Sr., from whom they very appropriately derive their title.

"Hutchinson's triad" is commonly taken to mean the association of—

1. Notched and pegged upper, central, permanent incisors.
2. Interstitial keratitis or the scar thereof, and
3. Nerve deafness.

But though these three are the most striking of the lesions in question, it is preferable to employ the term in a looser sense to cover all.

1. Dental stigmata,
2. Ocular stimata, and
3. Aural stigmata.

Dental Stigmata.—The dental stigmata of hereditary syphilis are due to arrested development of the teeth in the process of formation. Permanent incisors and the sixth-year molars are the teeth most often affected because they are in process of formation during the first three months of extrauterine life—i. e., at the very time when hereditary syphilis shows its greatest virulence.

Hereditary syphilis may, however, impart to the teeth almost any malformation in size, position, and shape. Fournier, who has made a special study of this matter, describes some ten varieties of syphilitic dental deformities.

Hutchinson's Teeth.—This deformity, though not peculiar to any tooth, is usually confined to the permanent upper, median incisors. It is not absolutely pathognomonic of syphilis.

Typical Hutchinson's incisors are abnormally small, pegged (i. e.,

tapering inward from above downward), and show a peculiar erosion of the free border. This erosion forms an absolutely regular crescentic bevel of the anterior surface of the free border of the tooth. When the tooth erupts, its free border is quite rough, but this roughness rapidly wears away, leaving a typical Hutchinson's tooth, which retains its characteristics for some fifteen or twenty years. But by the time the patient reaches the age of twenty or twenty-five the bevel edge is all worn off. Hutchinson's teeth are almost always symmetrically bilateral, and affect the permanent, upper, central incisors, which are often somewhat displaced, usually converging toward each other.

Fournier's Teeth.—Fournier has described a less characteristic deformity of the sixth-year molar, which he says is even more common than Hutchinson's teeth.

The deformity consists in an erosion of the summit of the tooth. About three-fourths of the tooth is entirely normal; the terminal fourth "is diminished in all its diameters, irregular, eaten, as though atrophied, and separated from the healthy part by a circular ridge." After five or ten years of use this eroded crown wears away, leaving a short tooth with a smooth top, to which Fournier attaches considerable diagnostic significance.

Parenchymatous Keratitis.—Parenchymatous keratitis, though it may occur in the first months of extra-uterine life or even before birth (Parinaud), and as late as the thirty-sixth year (Huguenin), is common only between the eighth and the fifteenth year (Hutchinson). It is one of the frequent manifestations of hereditary syphilis, occurring very frequently (59 per cent, according to Huguenin). On the other hand, it is not absolutely pathognomonic of syphilis. Though Hutchinson places great weight upon it as a diagnostic sign, careful investigation reveals other evidences of syphilis in not much more than one-half the cases (36 per cent, according to Alexander; 55 per cent, according to Michel). Hence it is not of itself an absolute proof of the existence of syphilis. Interstitial keratitis may occur in acquired syphilis.

Auditory Stigmata.—Deafness may result either from lesions of the middle ear or from those of the inner ear or of the nerve. Middle-ear deafness is only indirectly due to syphilis, and is much more often due to other causes. But internal ear or "nerve" deafness in children or young persons is almost exclusively due to syphilis.

TREATMENT IN INFANCY

Prophylaxis by thorough salvarsanization of the syphilitic mother before the fourth month of gestation is practically certain to save the fetus from infection. Later in pregnancy it may succeed.

The treatment of hereditary syphilis is based upon the same rules as is that of acquired syphilis, with the important difference that our hygienic efforts are confined almost solely to the matter of diet, mother's milk being quite as important as doctor's mercury.

The Wassermann reaction is done on blood obtained from the child's back by scarification and cupping. The suction must be gentle for fear of breaking up the red blood cells.

Salvarsan is given intravenously on the same principles as to the adult. The accepted dose is 0.01 gm. per kilogram of body weight. To infants it may be administered in a vein of the scalp or in the external jugular (while the child is crying).

The duration of routine treatment in infancy should cover the first two years, just as in adult life. A very brief treatment may suffice to quell the disease. But it is the part of wisdom to clinch the advantage gained by a course similar to that employed for the adult and covering the first two years. In infancy, however, the following rule applies:

Mercury may be given by injection or by inunction. Intramuscular injections have found little favor, though the employment of both the soluble and the insoluble salts has been urged.

The usual treatment consists in the application of the officinal ung. hydrargyri, diluted with two or three parts of vaselin (reducing it to one-third or one-quarter strength). This is laid on the belly band and renewed with it. No special precautions need be taken to prevent irritation of the skin, and the application may be continued daily throughout the treatment with only such intermissions as may be required by the appearance of diarrhea, dermatitis, or intercurrent disease.

Injections may be employed in about one-tenth the adult dose. This dose may be doubled at the time of second dentition, and trebled thereafter.

Local Treatment.—The baby's skin must be kept absolutely clean and dry, diapers frequently changed, and powder freely used. Erosions and condylomata are to be treated, as in the adult, by drying and calomel powder; but it is safer to dilute the calomel with two parts of starch or talcum powder.

The nasal congestion in snuffles may be somewhat reduced by anointing the inside of the nose with ammoniated mercury ointment. Since stomatitis does not occur in infancy, no especial care of the mouth is required; but erosions and fissures upon the lips may be touched once a week with the nitrate of silver stick.

It is safer, as a general rule, not to incise the furunculoid lesions, inasmuch as they are discrete and are often cheesy rather than suppurative; but when at the surface or already burst, they should be cleansed daily, or twice a day, with hydrogen peroxid diluted to one-half strength.

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